

UNIVERSITY OF CAPE TOWN

The Disposition Effect in South African Equity Markets

James Bashall (BSHJAM001)

Research dissertation presented for the approval of the University of Cape Town Senate in fulfilment of part of the requirements for the degree of Master of Commerce specialising in Finance (in the field of Financial Management) in approved courses and a minor dissertation. The other part of the requirement for this qualification was the completion of a programme of courses.

I hereby declare that I have read and understood the regulations governing the submission of Master of Commerce dissertations, including those relating to length and plagiarism, as contained in the rules of the University, and that this dissertation conforms to those regulations.

Supervisors:

Darron West & Gizelle Willows

August 2014

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

Abstract

The “disposition effect” describes the propensity for investors to realise gains sooner than losses through selling profit making investments more readily than loss making investments. This behaviour has been observed in financial markets across the world and across all investor classes, albeit to varying degrees.

Such trading behaviour has been found not to be profit or utility maximising. In the absence of rational motives for the disposition effect, it is concluded as being an irrational feature of investor trading behaviour. In search of the reason behind this behaviour, behavioural finance is turned to. No concrete justification for the disposition effect has been isolated as being the sole cause for this apparently irrational trading behaviour.

This study tests for the disposition effect in a South African context across two classes of non-professional investors: those acting in their own capacity, and those acting with the assistance of professional investment advisors. The trade history of a sample of 4 840 investor accounts from a South African stockbroker was analysed over the five year period from October 2008 to October 2013. Three primary issues were addressed: (i) whether South African investors exhibit the disposition effect, (ii) if this behaviour is reduced by non-professional investors through the employment of professional advice, and (iii) if this trading behaviour can be justified based on rational grounds in a South African context.

The results showed, consistent with studies elsewhere in the world, that individual investors in South Africa do exhibit the disposition effect both when acting in their own capacity and when acting with the assistance of professionals. Investors acting with the assistance of professional advisors are found, however, to show the effect to a lesser extent. Further, trading consistent with the disposition effect by investors acting with the assistance of professional advisors is found to be rationally justifiable on the grounds of portfolio rebalancing. It is therefore concluded that professional advice reduces the extent to which this irrational trading behaviour is exhibited, thereby increasing investor profits and utility.

Table of Contents

Introduction	1
Literature Review	3
Summary	3
The Disposition Effect.....	4
Rational explanations for the disposition effect	5
Behavioural Finance	8
Cognitive psychology.....	9
The limits to arbitrage	9
Behavioural finance applied to irrational behaviour	10
Behavioural biases driving the disposition effect.....	10
1. Prospect theory	10
2. Regret and Pride	14
3. Irrational expectation of short-term mean-reversion	16
4. Overconfidence, belief perseverance and the confirmation bias	16
5. Self-control	19
Implications of the disposition effect on trading profits and market efficiency	19
Effect on trading profits	19
Market efficiency.....	21
Under-reaction to news	22
Stock price momentum	22
Conclusion	23
Method.....	24
Research Questions	24
Research Approach	25
Odean (1998a).....	25
Shapira and Venezia (2000).....	26
Research Strategy.....	26
Research Method: The Data.....	27
Research Process.....	30
Testing for the disposition effect	30
Do individual equity investors investing independently of professionals and in South African markets exhibit a disposition to sell winning stocks more readily than losing stocks?.....	33
Does the advice of professional stockbrokers reduce the amount by which the disposition effect is exhibited?	34

Do individual equity investors investing in South African markets have a higher propensity to sell losing stocks as the tax year of assessment draws to a close?	35
Can the anomalous behaviour be explained by the desire to rebalance portfolios?.....	36
Ethics	37
Limitations/Risks	37
Results	39
Do individual equity investors investing independently of professionals and in South African markets exhibit a disposition to sell winning stocks more readily than losing stocks?.....	39
Does the advice of professional stockbrokers reduce the amount by which the disposition effect is exhibited?	40
Do individual equity investors investing in South African markets have a higher propensity to sell losing stocks as the tax year of assessment draws to a close?	41
Can the anomalous behaviour be explained by the desire to rebalance portfolios to restore diversification?	43
Analysis of results.....	44
Conclusion	48
Conclusion	50
Summary of results	50
Conclusion	50
Recommendations and areas for further research	51
Bibliography	53
Appendices	58
Appendix 1: Behavioural Finance	58
Appendix 2: Prospect Theory	60
Appendix 3A: Sample Data (full sample)	63
Appendix 3B: Sample Data (aggregated monthly)	65
Appendix 3C: Sample Data (whole sales only)	67
Appendix 4: Results of testing.....	69
Appendix 5: Analysis of results.....	72

Introduction

The “disposition effect”, the propensity for investors to sell profitable investments ahead of loss-making investments, is a characteristic of investor behaviour which has been found to occur in financial markets across the world. No rational explanation for this behaviour is found to exist; trading consistent with the disposition effect is found to be sub-optimal from a post-tax profit perspective, and is found not to be justified by conscious portfolio rebalancing. Trading consistent with the disposition effect is therefore considered to be irrational and behavioural theories are proposed as justification for it. The extent to which the disposition effect is exhibited is found not to be uniform across all investor classes, however, with professional investors exhibiting the disposition effect to a lesser extent when compared to non-professionals.

The purpose of this dissertation is three-fold: first, to test if the disposition effect is observed in South African equity markets, second, to test if the effect is reduced by investors acting with the assistance of professionals, and third, to test if the effect can be justified based on the rational reason of rebalancing of portfolios.

Chapter 2 reviews literature relevant to the disposition effect. First, literature focusing directly on testing for the disposition effect and testing for justifications for the effect on rational bases is considered. In the absence of conclusive rational justifications for the disposition effect, literature proposing behavioural finance theories as a justification for the disposition effect is considered. Finally, the implications of the disposition effect on investor profits and market efficiency is considered.

The findings of the literature review drive the research questions to be investigated so as to address the purpose of this dissertation. The research questions are stated in chapter 3 along with the research approach to be followed in addressing each of the research questions. The research approach is discussed in light of the data sourced for this dissertation, as well as the statistical methods employed in establishing the significance of results generated.

The results of the research methods executed are discussed in chapter 4. The results are discussed in light of the literature reviewed in chapter 2 in order to justify and contrast the relative findings in South Africa to those in other countries. The results are investigated further where possible given the limitations imposed by the data set employed.

The final chapter, chapter 5, sets out the conclusions of the study in light of the results in chapter 4 and the literature reviewed in chapter 2. Proposals of areas for future research based on the results of this dissertation will also be set out.

Literature Review

Summary

The “disposition effect” describes the propensity for investors to realise gains sooner than losses through selling profit making investments more readily than loss making investments. This behaviour has been observed in financial markets in the US, Europe, the Middle-East, and Asia and is widely accepted as a consistent feature of investor behaviour. The reason investors exhibit this propensity is, however, uncertain.

Four potentially rational explanations for the disposition effect have been investigated historically: tax liability optimisation, future stock performance expectations, rebalancing of portfolios to restore diversification, and the relative trading costs of winning and losing investments. Empirical investigation of each of these explanations has concluded that none of them justify the disposition effect, resulting in the conclusion that the propensity to sell winning stocks ahead of losing stocks is irrational. Behavioural finance is therefore turned to in an attempt to explain this apparently irrational behaviour.

Traditional finance theory hinges on the assumption that investors behave rationally. Behavioural finance seeks to explain deviations from rational behaviour by investors using “cognitive psychology”. Prospect theory, mental accounting, regret and pride, the irrational expectation of short-term mean-reversion, overconfidence, self-attribution and self-control are all offered and tested as explanations of the disposition effect from a behavioural finance perspective. Prospect theory and overconfidence are concluded to be the most likely causes of the disposition effect, although it is also concluded that no single behavioural bias is solely accountable.

The disposition effect has implications for both trading profits and market efficiency. It has been proven that investors who exhibit the disposition effect achieve sub-optimal investment returns as a result. All investors are not equally subject to the disposition effect, however, with less sophisticated traders being more likely to be subject to the disposition effect. The effect of the disposition effect on market efficiency is anticipated as a result of the irrational trading on the part of market participants, and is linked to the financial market anomalies of post-announcement price drift and stock price momentum.

This chapter reviews the literature published on the disposition effect.

The Disposition Effect

Many empirical studies in recent decades have proven systematic behaviour on the part of investors which appears to be inconsistent with the paradigm of rational expectations (Strobl, 2003). One example of this behaviour is the “disposition effect”. The “disposition effect” describes the propensity for investors to realise gains (winners) sooner than losses (losers) through selling profit making investments more readily than loss making investments (Barberis & Xiong, 2009; Dhar & Zhu, 2002; Odean, 1998a; Shefrin & Statman, 1985).

The disposition effect was first observed based on US data for individual and institutional investors by Shefrin and Statman (1985) when examining people’s propensity to realise gains and losses in a financial market context so as to minimise their tax liability. Shefrin and Statman's (1985) study returned the observation that financial market participants fail to act in accordance with the normative optimal tax strategy for realising gains and losses in the short term as presented by Constantinides (1983). It was also observed that market participants showed a clear aversion to realising losses, a disposition Shefrin and Statman (1985) decided to label the “disposition effect”.

Subsequent to the initial identification of the effect by Shefrin and Statman (1985), Odean (1998a) sought to establish in a more robust test whether or not market participants exhibit the disposition effect. Odean (1998a) did not limit the observation of investor disposals to the short term disposals per Constantinides' (1984) normative tax trading strategy; Odean (1998a) tested all disposals by investors, regardless of their motive, over a longer investment horizon. Using the trading records of 10 000 retail trading accounts over a six year observation period, Odean (1998a) compared the realisation, through sale, of paper gains and losses by investors.

Odean (1998a) concluded that it was not sufficient to merely look at the number of stocks sold at a profit versus the number of stocks sold at a loss in establishing whether a disposition to sell winners ahead of losers existed. Merely looking at gross gains and losses realised would be skewed by the general direction of the market: skewed towards more gains being realised by an upward moving market, and skewed toward more losses being realised in a downward market. Odean (1998a) therefore sought to compare the amount of gains and losses realised relative to the investor’s opportunity to do so. If an investor’s proportion of gains realised (realised gains divided by the amount of opportunities to realise a gain) exceed the proportion of losses realised (realised losses divided by the amount of opportunities to realise a loss), the investor is observed to have a higher propensity to realise gains than losses, and is therefore exhibiting the disposition effect. The results of the study showed that investors were approximately 50% more likely to realise paper gains than losses, illustrating that investors were more likely to sell winning stocks than losing stocks.

Therefore, based on the sample, investors were found to exhibit the disposition effect (Odean, 1998a).

In response to Odean's (1998a) paper, using the same method, the disposition effect has been tested and statistically observed in the equity markets of Israel (Shapira & Venezia, 2000), Finland (Grinblatt & Keloharju, 2001b), China (Feng & Seasholes, 2005), Australia (Brown, Chappel, Da Silva Rosa, & Walter, 2006), Taiwan (Barber, Lee, Liu, & Odean, 2007) and India (Prosad, Kapoor, & Sengupta, 2013).

The disposition effect was found to be present in Initial Public Offering (IPO) trading volumes by Kaustia (2004). Kaustia (2004) argues that the disposition effect should be the strongest in the case of IPOs because all IPO investors have the same purchase price. Kaustia (2004), when analysing US IPOs from 1980 to 1996, found that trading volumes are significantly lower following an IPO in which negative returns are experienced immediately following the listing, than when the IPO has a positive return immediately after the listing. Trading volumes are then observed to increase substantially on the day that the share passes the initial offer price. These trading volume observations, according to Kaustia (2004), are further proof of the presence of the disposition effect.

The disposition effect has been found not to be exhibited equally across all investors (Dhar & Zhu, 2002; Locke & Mann, 2003). Dhar and Zhu (2002) concluded that this was largely due to differential investor sophistication across investors, with professional investors' increased sophistication rendering them much less likely to exhibit the disposition effect than non-professionals.

The observation of the disposition effect has not been limited to equity traders only. The disposition effect has also been observed in the real estate market in Boston, USA (Genesove & Mayer, 2001), in the trading patterns of professional futures traders (Locke & Mann, 2000), and in the exercise of executive stock options (Heath, Huddart, & Lang, 1999).

There is extensive literature documenting the existence of the disposition effect, suggesting that it is a regular feature of financial and other markets. The reason for this behaviour is not clear, however. This will be discussed next.

Rational explanations for the disposition effect

It is difficult to explain on rational grounds why the disposition effect is observed (Barberis & Thaler, 2003). Rational explanations for this trading behaviour have been investigated in terms of (1) tax liability optimisation, (2) future stock performance expectations, (3) the need to rebalance portfolios to restore diversification, and (4) the relative trading costs incurred in the sale of winners and losers.

1. Tax liability optimisation

Disposition effect linked trading could be justified as rational were it to conform to best practice in the optimisation of investors' after-tax returns (Odean, 1998a). Constantinides (1984) showed that the after-tax return realised on investments can be increased by investors if they realise their losses, and defer the realisation of gains. From a tax perspective, this would allow investors the tax benefit of a capital deduction in the current tax period, while deferring the tax payable on the realisation of capital gains into a future period. In pursuit of profit maximisation by consideration of tax consequences, therefore, investors should be expected to realise losses more readily than gains (Barberis & Thaler, 2003; Odean, 1998a; Shefrin & Statman, 1985). Investor share trading does not display this effect, however, as illustrated in the observation of the disposition effect where gains are realised more readily than losses

Increased trading volumes of loss making investments relative to profit making investments has, however, been observed immediately prior to the tax year ends in the USA by Grinblatt and Moskowitz (2004), Odean (1998a), Poterba and Weisbenner (2001) and Ritter (1988). In spite of this, however, investors are more likely to realise gains than losses over time (Barber & Odean, 2000, 2001, 2003; Grinblatt & Keloharju, 2001a; Odean, 1998a). Disposition effect type trading therefore does not conform to best practice when considering tax liability optimisation, and therefore cannot be justified as rational on this basis (Grinblatt & Keloharju, 2001a; Odean, 1998a).

2. Future stock performance expectations

Trading consistent with the disposition effect could be rational were it to be based on the expectation that losers will outperform winners in the future, inferring that the optimal trading strategy would be to sell winners and hold onto losers (Brown et al., 2006; Odean, 1998a). This expectation arises when an investor purchases stock based on the evaluation that the stock is undervalued relative to its true intrinsic value (fair value) per the investor's valuation. If the price of the investment appreciates and reaches the price which the investor initially thought to be the fair value of the stock (provided the investor does not update their opinion as to the true value of the stock after purchase) the investor will sell the stock as he does not expect any future return from the stock. On the other hand, if the stock price falls post purchase, the price will not yet reflect the investor's opinion as to its intrinsic value. Provided the investor does not update their opinion about the stock's intrinsic value, this will prompt the investor to hold onto the stock until the share price rises and the intrinsic value is reached (Lakonishok & Smidt, 1986). This would be entirely rational behaviour (Strobl, 2003).

However Barberis and Thaler (2003), Odean (1998a) and Strobl (2003) have all found that the winners sold by investors tend to outperform the losers not sold over the following 6 to 24 months; showing that holding shares on the basis that the expected future performance of losers outweighs winners is not justified. Odean (1998a) is of the opinion that this empirical fact proves that the belief that losing stocks will outperform winning stocks in the future, is irrational.

Although the observation that winners sold tend to outperform losers not sold points to irrational behaviour on the part of traders (Barberis & Thaler, 2003; Odean, 1998a; Strobl, 2003), Strobl (2003) concludes that this behaviour can be explained on rational terms. Strobl (2003) finds that better informed investors (investors with relatively unknown information about a share) react to a sharp decline in information asymmetry immediately before a public news release by selling their winning investments and holding their losing investments. Further, he finds that less informed investors (investors without that relatively unknown information about a share) behave in the same way when information asymmetry increases or moderately decreases over time. These reactions to changes in relative information asymmetry between investors, which are in line with the disposition effect, are judged by Strobl (2003) to be entirely rational, therefore proving that disposition effect trading can be rational.

Relative information asymmetry is not a pervasive observation, however, and does not explain all cases of disposition effect behaviour (Strobl, 2003). On the whole, therefore, it is concluded that selling winners and holding losers, behaviour consistent with the disposition effect, is not rational on the basis of relative future stock performance expectations.

3. Rebalancing portfolios to restore diversification

The justification for the disposition effect on the grounds of portfolio rebalancing is as follows: for an investor holding a diversified and balanced portfolio, a large price increase of a stock would skew the portfolio in favour of that winning stock. In order to maintain portfolio diversification, the investor would be required to rebalance their portfolio by selling a portion of their holding in the winning stock, therefore reducing its relative weight in the portfolio to a state of balanced diversification (Lakonishok & Smidt, 1986; Strobl, 2003).

However, Odean (1998) does support this as an explanation for the disposition effect. In order for this theory to hold as a rational explanation for the disposition effect, traders would need to be observed to sell a portion of their holding in winning stocks so as to restore the weight of that stock in the portfolio to that which it was before its price increased. The sale of an entire holding of a stock is unlikely to be related to rebalancing of a portfolio (Odean, 1998a). To control for this explanation, Odean (1998a) removed all partial sales of stocks from his sample, and re-ran his test of relative

gains and losses realised. Although the method is acknowledged not to be perfect, it should greatly reduce the noise introduced by rebalancing (Odean, 1998a). When partial sales are ignored, the preference to sell winners ahead of losers is not markedly changed, leading to Odean's (1998a) conclusion that the disposition effect is not caused by investors' propensity to rebalance portfolios to restore diversification.

The findings of Odean (1998a) were supported by Brown et al. (2006) in an Australian context using the same method. It can hence be concluded that the rebalancing of portfolios on the part of investors is not a valid justification for the disposition effect.

4. Relative trading costs of selling winners and losers

Harris (1988) proposed that the relative trading costs of winners and losers could explain the disposition effect. This is based on two premises: first that transaction costs tend to be relatively higher for lower priced stocks, and second because losing investments are more likely to be lower priced as a result of the loss being incurred relative to winners. Because of these premises, investors are reluctant to sell losing stocks to avoid paying relatively higher transaction costs. Odean (1998) proved this theory not to hold through comparing sales of stocks of similar sizes, thereby controlling for the variable inherent in relative transaction costs. In the case of sales of stocks of similar sizes, Odean (1998a) found that investors still exhibited the disposition effect. This conclusion was supported by Brown et al. (2006) in an Australian context.

Conclusion as to the rational explanations for the disposition effect

The literature reviewed above finds that none of the proposed rational explanations for investors exhibiting the disposition effect hold. Therefore, behavioural biases under the ambit of behavioural finance have been cited as the primary cause of this irrational behaviour (Barberis & Thaler, 2003). The relevant behavioural explanations for the disposition effect are considered below.

Behavioural Finance

Traditional finance theory is based largely on the assumption that financial market participants are rational and utility maximising (Barberis & Thaler, 2003; Ritter, 2003; Weber, Glaser, & Noth, 2003). This assumption results in the theoretical equilibrium of efficient markets because of the expected rational response of investors to publicly available information per the Efficient Market Hypothesis (see Appendix 1(a) for more information) (Fama, 1970; Malkiel, 2003; Shiller, 2003). When market participants act outside of this rational paradigm, it is expected that inefficiencies introduced by irrational trading will be removed by arbitrage traders: those traders who identify inefficiencies in the market and are able to make a risk free profit off them. Through capitalisation on arbitrage

opportunities, arbitrage traders restore the market to the equilibrium expected per the Efficient Market Hypothesis. This is called a “no-arbitrage” condition (Weber et al., 2003). However, financial markets fail to exhibit this expected equilibrium in reality, as illustrated in the stock market booms and crashes observed in Japan in the late 1980s, worldwide in 1987, in the U.S. in the “internet bubble” of the late 1990s (Malkiel, 2003; Ritter, 2003) and in the global financial crisis in 2008.

The two assumptions underpinning the efficient market hypothesis (rational investors and the no-arbitrage condition) have been found not to hold in empirical studies (Tseng, 2006). Behavioural finance argues that this deviation from expectation can be partially explained by two premises: first that not all market participants are entirely rational as a result of their cognitive psychology, and second that there are limits to arbitrage (Barberis & Thaler, 2003; Ritter, 2003). These two premises form the fundamental pillars upon which behavioural finance has been developed (Tseng, 2006).

Cognitive psychology

The primary assumption that market participants are rational falls flat when it is observed that deviations from rational behaviour on the part of market participants, as a result of psychological biases, are systematic (Ritter, 2003). “Cognitive psychology” refers to the psychology of how people think (Ritter, 2003). The observation that investors behave systematically irrationally in their investment choices can be explained by the research of cognitive psychologists on the biases which are observed in people’s beliefs and preferences (Barberis & Thaler, 2003). There is a wealth of psychological literature finding that people make systematic errors in the way that they think and make decisions (Barberis & Thaler, 2003; Odean, 1998a; Ritter, 2003; Shleifer & Vishny, 2008). Behavioural finance seeks to apply these observed biases to financial decision making in order to explain the deviations from modern finance theory in the way financial markets behave (Ritter, 2003).

The limits to arbitrage

Theoretically, market mispricing caused by systematic irrationality of investors should be eradicated by arbitrage investors who would trade on mispriced assets, resulting in the returning of asset prices to equilibrium before the mispricing becomes too large (Ritter, 2003). Arbitrage theoretically entails the realisation of a risk free return without capital investment. In reality, this is not the case, as arbitrage is rarely risk free and requires substantial capital investment (Shleifer & Vishny, 2008). Further, it is assumed that arbitrage investors are able to take the positions in financial markets necessary to take advantage of asset mispricing so as to profit off that mispricing (Ritter, 2003). This often does not hold in reality due to market liquidity and investor liquidity constraints, causing arbitrage to fail in its role of correcting the mispricing caused by systematically irrational investors

(Barberis & Thaler, 2003; Ritter, 2003; Shleifer & Vishny, 2008). The limits to arbitrage are discussed further in Appendix 1(b).

Behavioural finance applied to irrational behaviour

Despite cognitive psychology explaining to some extent through psychological studies why investors behave systematically irrationally, this alone does not explain deviations from traditional finance theory (Barberis & Thaler, 2003; Ritter, 2003). The limits to arbitrage do, however, complete the explanation of the deviations from traditional finance theory: market mispricing caused by irrational investor decision making because of inherent cognitive psychological flaws are not always resolved by arbitrage (Ritter, 2003), resulting in inefficient markets.

Observations of irrational investor behaviour, like the disposition effect, can hence be linked to psychological behavioural biases. This can then be used to try explain both why investors behave irrationally, and what the effect of such irrational behaviour will be on the efficiency of financial markets (Barberis & Thaler, 2003).

Next, this study looks at the behavioural biases identified under the ambit of behavioural finance which could potentially explain the irrational behaviour on the part of investors which leads to the disposition effect.

Behavioural biases driving the disposition effect

The study of behavioural finance has led to the identification of a number of biases and theories which describe the irrational behaviour of investors (Tseng, 2006). This section describes the behavioural theories linked with the disposition effect: (1) prospect theory (Kahneman & Tversky, 1979) (inclusive of mental accounting (Thaler, 1985)), (2) regret and pride (Shefrin & Statman, 1985), (3) irrational belief of short-term mean-reversion (Odean, 1998a), (4) overconfidence (Barber & Odean, 2001) (inclusive of self-attribution (Hirschleifer, 2001)), and (5) self-control (R. H. Thaler & Shefrin, 1981).

1. Prospect theory

Prospect theory was developed by Kahneman and Tversky (1979) as a review of utility theory in response to the empirical finding that conventional utility theory failed to describe how people make decisions under conditions of risk and uncertainty (refer to Appendix 2 for a summary of conventional utility theory, prospect theory, and how the two theories differ). First, the application of prospect theory as an explanation for the disposition effect is explained. Two of the key observations underpinning prospect theory are then considered in more detail: the reference point

and loss aversion. Finally, empirical application of prospect theory to the disposition effect is considered.

1.1. Application of prospect theory to the disposition effect

Prospect theory is applied to investment decision making as follows: suppose an investor buys a stock he believes to be undervalued in the market. The investor is assumed to have an expected return high enough to justify the investment risk. If the stock price appreciates to the investor's expected value, and the investor views the original purchase price as the reference point from which gains are determined, the stock will be in a more concave, risk averse part of the value function; a price movement down will result in a greater utility loss than an equal increase in the share price. If the investor does not increase their expected value of the stock from the original expectations, their risk aversion to holding the stock will most likely prompt the sale of the stock (Odean, 1998a).

Suppose rather, that the value of the stock decreases instead of appreciating. The stock will now be in a more convex, risk seeking part of the value function; a price movement up will result in a greater utility gain than the utility loss for an equal decrease in the share price. The investor is now expected to hold the stock even if their expected return on the stock declines relative to that at the time of purchase: the utility expected from a marginal price gain exceeds the loss of utility from a price loss, hence justifying the risk of taking on further loss. The expected return on the stock must decline further in the case of a losing stock than for a winning stock in order to prompt a sale (Odean, 1998a).

The implications of this value function to a portfolio results in the disposition effect: if an investor were to be holding two stocks, one of which is up and the other down relative to the initial purchase price, the investor would be more inclined to sell the up stock than the down stock if a liquidity demand were to arise (Odean, 1998a). This would therefore result in a disposition to sell winning stocks ahead of losing stocks.

1.2. Key assumptions in the application of Prospect Theory

Prospect theory and its application to the disposition effect entail many assumptions. The most important assumptions are the reference point from which gains and losses are determined and loss aversion.

1.2.1. The Reference Point: mental accounting

The reference point from which gains and losses are calculated defines whether or not a person is in a gain or loss making situation with regards to an ex-post decision (Kliger & Kudryavtsev, 2008; Odean, 1998a). The reference point is therefore integral to the application of prospect theory to the

disposition effect because it is based on the investors gain or loss making position that we judge the disposition effect. The application of the reference point per prospect theory to share trading is linked to the theory of “mental accounting” (Shefrin & Statman, 1985).

Thaler (1985), in his work attempting to explain how people evaluate and respond to economic outcomes, proposed the theory of “mental accounting”. Mental accounting describes the propensity of people to separate gambling decisions into independent accounts, and then apply prospect theory based decision making independently to each account while ignoring possible interaction between them (Shefrin & Statman, 1985; R. Thaler, 1985). The observation that gambling decisions are separated and not considered in aggregate supports the proposition of prospect theory that gains and losses are defined relative to a reference point rather than to overall wealth (Shefrin & Statman, 1985). Further, mental accounting assists in the determination of the correct reference point, used by investors, to which prospect theory can be applied (Odean, 1998a).

The application of mental accounting to equity investments suggests that an investor’s reference point for a stock is its purchase price. This is because when a new stock is purchased, a new mental account is opened, and the reference point for that stock is its cost. People then track that purchase’s performance in its separate mental account relative to that initial reference point, never adjusting the reference point for changes in overall wealth because those changes are deemed to apply to other mental accounts. (Shefrin & Statman, 1985)

In the application of prospect theory to the disposition effect, in line with the reference point proposed by mental accounting, Odean (1998) uses the original purchase price of the share as being the reference point from which gains and losses are evaluated by investors. This poses a challenge when considering share-holdings which are long term and are changed by purchase and sales at irregular intervals (Odean, 1998a). For example, a shareholder’s reference point will likely be updated (upwards) for a share which has appreciated greatly in value and stayed stable at a higher value for an extended period of time. If the share price were to drop from that high, the investor would likely view that result as a loss, hence suggesting a shift in the reference point (Odean, 1998).

Kliger and Kudryavtsev (2008) argue that investors modify their reference point upon arrival of new information about the stock held. For example, if an unexpected earnings announcement is made, investors will adjust their reference point. Kliger and Kudryavtsev (2008) failed to find a definitive statistical method for the updating of a reference point in testing for the disposition effect. Odean (1998) therefore concludes that the purchase price is the major component of the reference point for an investor and as a result is the closest, albeit noisy, proxy available.

1.2.2. Loss aversion

The property of the value curve being steeper in gains than in losses reflects the observation that individuals are loss averse (Kahneman & Tversky, 1979). Loss aversion is a key contributor to the explanation of the disposition effect using prospect theory, and is clearly observed in investor decision making (Shefrin & Statman, 1985). Gross (1980) observes that people are very reluctant to realise losses, and are hence willing to take the risk that the investment could decline further for the reward that it may return to the level at which they originally purchased the investment. Gross (1980) also infers that the realisation of a loss through sale as opposed to leaving it as a paper loss amounts to an aversion to admitting the fault of having made a poor investment in the first place. People are willing to take on more risk in a loss making situation to avoid this admission of failure (Gross, 1980).

1.3. Application of prospect theory to the disposition effect: empirical study

Despite prospect theory having been identified as the primary driver of the disposition effect, it is almost always discussed in informal terms (Barberis & Xiong, 2009). Barberis and Xiong (2009) sought to create a rigorous formal model which could be used to predict the disposition effect based on prospect theory. They propose two separate implementations of prospect theory: one in which prospect theory is applied to annual stock-level trading profits, and one in which prospect theory is applied to realised gains and losses as they are made. The difference between these two implementations lies in when the utility from the profits on sale of shares arises: at a periodic interval at which point the periodic gains and losses (both paper and realised) are tallied, or as sales are made and gains and losses are realised in cash (Barberis & Xiong, 2009).

Through the formal modelling of two implementations of prospect theory, Barberis and Xiong (2009) found that the second implementation, based on realised gains and losses, predicts the disposition effect reliably. Implementation based on annual gains and losses was found not to predict the disposition effect. This is consistent with Gross's (1980) observation of paper versus realised gains and losses. Utility achieved through realising gains and losses resulting in the disposition effect are therefore concluded in part to be caused by irrational investor behaviour as described by the prospect theory asymmetric utility function (Barberis & Xiong, 2009).

Hens and Vlcek (2009), also in an attempt to conclude as to whether prospect theory explains the disposition effect or not, concluded that prospect theory does not explain the disposition effect in its entirety. They propose the consideration of other behavioural biases which, together with prospect theory, result in investors exhibiting the disposition effect.

Prospect theory was initially cited as the primary reason driving the disposition effect (Odean, 1998a; Shefrin & Statman, 1985). Although it was concluded to be the primary cause of the disposition effect by Barberis and Xiong (2009), prospect theory is an inconclusive explanation for the disposition effect (Hens & Vlcek, 2009). Further behavioural theories have therefore subsequently been linked to this behaviour in an attempt to provide a more complete justification for the observation. These are considered next.

2. Regret and Pride

Regret refers to the negative emotion evoked by the knowledge that a different choice in the past would have resulted in a better outcome at some point thereafter (O'Curry Fogel & Berry, 2006). Regret theory assumes that people anticipate the feelings they expect to feel as a consequence of decisions made, and take these anticipated feelings into account when making decisions (Zeelenberg, Beattie, van der Pligt, & de Vries, 2005).

Loss aversion, as discussed above, is a key observation on which prospect theory is based (Tversky & Kahneman, 1992). Prospect theory bases the assumption of loss aversion on the premise that expected utility depends on the possible pain and pleasure associated with the outcomes of an option, weighted for the probability of occurrence (Zeelenberg, Beattie, van der Pligt, & de Vries, 2005). Prospect theory, in contrast to regret theory, does not take into account the feelings evoked by the outcome itself. Regret theory takes loss aversion one step further and states that people compare the final outcome of a situation to other possible outcomes, and feel emotions based on whether their outcome was better or worse than other alternatives (Zeelenberg et al., 2005).

In a financial context, investors feel regret when their investment yields a lower return than an alternative investment option. Regret is viewed by Michenaud and Solnik (2008) as such a strong negative emotion that it may cause people to make sub-optimal, irrational decisions contrary to those predicted by rational utility theory. Investors do not just take into account the expected utility of monetary gains or losses in an investment decision; they also factor into the decision the regret they expect to feel given possible outcomes to the investment decision (Michenaud & Solnik, 2008).

Shefrin and Statman (1985) proposed regret and pride as being an explanation for the disposition effect. They hypothesise that pride associated with realising a gain, coupled with regret from making a losing investment, could contribute to the disposition effect. Pride, in the context used by Shefrin and Statman (1985), is the counterpart to regret.

The application of regret and pride is proposed as follows: if the share price of an investment decreases, and the investor realises a loss on that investment through sale, they will feel regret as a

result of the initial investment decision. In the hope of a reversal in the share price movement in the next period, and therefore avoidance of regret due to a realised loss, they will hold onto the stock. If the share price of an investment increases, the investor wants to feel pride in having made a good investment, and therefore sells the investment to realise the gain. If, however, the investor in the case of a winning investment were to continue to hold the investment and the share price were to fall, they would forego pride and would regret the decision not to sell the share at its peak share price. Their need to feel pride and to delay regret therefore results in investors realising gains ahead of losses, thereby exhibiting the disposition effect. (Muermann & Volkman, 2006; Shefrin & Statman, 1985).

Shefrin and Statman's (1985) theory is based on the observation that regret about having made a bad investment decision is not felt to the same extent if the loss is unrealised versus if it is realised (Muermann & Volkman, 2006). This is supported by research in regret theory which demonstrates that action is regretted more than inaction (Muermann & Volkman, 2006). This is because it is easier to imagine regret inducing alternatives to the decision a person has made in response to an action as opposed to inaction. By not selling a losing investment, an investor is therefore reducing the amount of regret they feel by reducing their thinking about what might have been had they invested in a profitable stock instead (Butler & Highhouse, 2000; Gross, 1980).

Muermann and Volkman (2006) acknowledge that there would be regret associated with the situation in which you sell a winning share in order to feel pride, and the share price increases further thereafter. It is concluded by O'Curry Fogel and Berry (2006), however, that the regret of losing on an investment outweighs the regret of a lost gain. This prompts an investor to prefer to sell a profit making investment and forego future gains were the share price to increase, rather than holding the profit making investment and incurring subsequent losses were the share price to decline. (O'Curry Fogel & Berry, 2006).

O'Curry Fogel and Berry (2006) found this theory to hold in the results of a survey of 500 American investors. Muermann and Volkman (2006) developed a model for expected utility given regret and pride investment decision making, and concluded that regret and pride do contribute to investors exhibiting the disposition effect.

Lee, Kraussl, and Paas (2012) sought to explicitly test, using real trading data, the proposal by Shefrin and Statman (1985) that regret and pride could be responsible for the disposition effect. The results of their comprehensive test were that expected regret and pride on the part of investors did predict the disposition effect. Their findings differed from the initially proposed regret and pride framework

in that they found both regret and pride to exist in both the domains of gains and losses. The balance of the two emotions results in the disposition effect. (Lee, Kraussl, & Paas, 2012)

The literature therefore finds the emotions of regret and pride, as felt by investors, to be an explanation for the disposition effect.

3. Irrational expectation of short-term mean-reversion

When considering the potential rational reasons for investors exhibiting the disposition effect above, Odean (1998a) considered whether the behaviour could be explained by future stock price expectations. On a rational basis, Odean (1998a) argued that if investors believe the stock price to have reached its intrinsic value, the sale of a winning stock would be justified. If a stock has not yet reached its intrinsic value, the sale of the stock would not be justified, hence resulting in losing stocks not being sold (Strobl, 2003).

In line with the findings of Andreassen (1988), Odean (1998) found that the expectation of future stock performance is based on the irrational expectation of short-term mean-reversion: the expectation that stocks will return to their original price in the near future. Ben-david and Doukas (2006) support this conclusion by finding that institutional investors show signs of trading based on the expectation of mean-reversion. Odean's (1998) finding that stock prices do not mean revert historically suggests that this belief is unjustified, however, and therefore irrational.

The expectation of short-term mean reversion, as proven by historic share price movements, is not rational. This bias causes the disposition effect to be observed as investors sell winning stocks in expectation of a drop in share price as it reverts to a mean price, and hold losing stocks in expectation of an increase in share price as it reverts to a mean price.

Short-term mean reversion is considered as a contributing factor to the disposition effect (Odean, 1998a). It is concluded to be a minor contributor to the disposition effect, however, as the belief in short term mean reversion is not pervasive across all investors and all trading decisions (Ben-David & Doukas, 2006).

4. Overconfidence, belief perseverance and the confirmation bias

People's behaviour suggesting that they have greater abilities than they actually do is referred to in psychology as overconfidence (Chen, Kim, Nofsinger, & Rui, 2007). Literature in cognitive psychology has found that people tend to be overconfident, and that they are particularly overconfident as to the accuracy of their knowledge (Odean, 1998b). Kahneman and Riepe (1998) comment on the effect on decision making of overconfidence as follows: "The combination of overconfidence and

optimism is a potent brew, which causes people to overestimate their knowledge, underestimate risks, and exaggerate their ability to control events.”

Overconfidence is widely accepted as being a feature of financial market participants, and is associated with overtrading on the part of overconfident investors (Barber & Odean, 2001; Chen et al., 2007; Odean, 1998b; Statman, Thorley, & Vorkink, 2006). Investors who are relatively overconfident can therefore be distinguished based on relative trading frequency (Statman, Thorley, & Vorkink, 2006).

Statman et al. (2006) argue that a primary driver of the disposition effect is investor overconfidence (Ben-David & Doukas, 2006). As a result of overconfidence, investors overestimate the accuracy of their own valuation abilities (Gervais & Odean, 2001). This causes investors to make investment decisions by relying primarily on their own private signals while ignoring public signals. This is subsequently exacerbated by “belief perseverance” which states that once people have formed an opinion, they stick to it too firmly and for too long.

In extreme cases, people have been found to exhibit the “confirmation bias” whereby they misinterpret evidence which contradicts their opinion as actually being in their favour (Barberis & Thaler, 2003). This contributes to disposition effect type behaviour as follows: Investors buy stocks when they are perceived, based on personal judgement, to be undervalued. This is consistent with rational trading behaviour. Investors then update their opinions asymmetrically between favourable and unfavourable signals. This is irrational. Favourable signals (share price increases) are seen as confirmation of their original belief which led to the stock being purchased, while unfavourable signals (share price decreases) are discounted on the basis that the market has not yet realised the true valuation of the share. As a result, investors do not to update their valuation of the underlying investment for information which comes to light subsequent to their investment decision, causing them to sell shares following price increases and hold onto their shares following price decreases; trading behaviour which is consistent with the disposition effect. (Ben-David & Doukas, 2006)

Empirical work done to date on investor overconfidence tends to suggest an attitude about the market as a whole, and not about individual stocks (Statman et al., 2006b). The disposition effect, on the other hand, is observed on an individual investment basis (Odean, 1998a; Statman et al., 2006b). This has resulted in the observation of overconfidence and the disposition effect being largely separated as two independent observations of irrational investor behaviour (Statman et al., 2006b). Overconfidence had therefore not been proven to be the cause of the disposition effect for

individual traders, and is often ignored as a possible cause of the disposition effect (Ben-David & Doukas, 2006; Statman et al., 2006b).

Ben-David and Doukas (2006) took the link between overconfidence and the disposition effect and sought to prove overconfidence to be a cause of the disposition effect for institutional investors. Their basis for the link between the two behavioural biases (overconfidence and the disposition effect) cited a third behavioural bias, termed the “self-attribution” bias. Biased self-attribution arises because “people tend to overestimate the degree to which they are responsible for their own success” (Weber et al., 2003). Self-attribution lends itself to overconfidence when it is assumed that people’s overconfidence is a function of past investment success (Hirschleifer, 2001; Statman et al., 2006b).

Ben-David and Doukas (2006) also introduced the hypothesis that overconfidence and the disposition effect are exacerbated by information ambiguities about facts upon which investment decisions are made. Information ambiguities increase the role of investors’ personal judgement when evaluating the investment decision (Ben-David & Doukas, 2006). Because overconfidence plays an important role when making a decision based on personal judgement, the link between overtrading and information ambiguities was made.

The result of Ben-David and Doukas's (2006) study was to show that investors are overconfident when facing information ambiguity and that they tend to overtrade as a result. The disposition effect was also observed when information ambiguities arose. This is because as a result of the information ambiguities, investors increased their sales of shares on which capital gains had been achieved in the past (winning investments), and held shares on which capital losses were achieved in the past (losing shares). This therefore linked overconfidence to disposition type behaviour (Ben-David & Doukas, 2006).

Psychological research has found that men are more overconfident than women in areas such as finance (Barber & Odean, 2001). Further, it is accepted that overconfidence leads to overtrading (Barber & Odean, 2001; Chen et al., 2007; Odean, 1998b; Statman et al., 2006a). Barber and Odean (2001) tested the hypothesis that as a result of women being less overconfident than men, they should not trade as excessively as men. They found that men traded 45 per cent more than women, proving their hypothesis.

In Barber et al.'s (2007) testing of the disposition effect in Taiwan, Barber et al. (2007) found, consistent with Barber and Odean (2001), that men traded more frequently than women. Contrary to the theory proposed by Ben-David and Doukas (2006), however, women were equally likely to

exhibit the disposition effect when trading. This result questions the relationship between overconfidence and the disposition effect, but in itself does not discredit the connection. (Barber et al., 2007)

5. Self-control

Shefrin and Statman (1985) propose a lack of self-control on the part of investors being responsible for their inability to realise losses. Shefrin and Statman (1985) use a model proposed by Thaler and Shefrin (1981) which identifies an internal conflict between a person's brain's rational farsighted "planner" and myopic "doer" components (Shefrin & Statman, 1985). While the "planner" part of a person's brain is rational and understands the irrational aspect of realising gains more readily than losses, as observed in the disposition effect, the "doer" part of the brain's myopic tendencies result in it conforming to the feelings and actions proposed by "regret and pride" above. Shefrin and Statman (1985) propose that the rational "planner" part of a person's brain is unable to override the emotional "doer" part of the brain, therefore exhibiting poor self-control, and resulting in the disposition effect.

Evidence of the existence of the rational part of investors' brains is given by Shefrin and Statman (1985) in the fact that investors use conscious predetermined techniques to resist the "doer" tendency not to realise losses. Examples of these techniques are rules like never letting the loss on a trade exceed ten per cent, or the use of automatic stop-loss orders. Such techniques take out the emotional consideration of selling losing investments, implying that investors are conscious of their irrationality when not selling losing investments (Shefrin & Statman, 1985).

Self-control is a theory that has attracted little academic attention in terms of its connection to the disposition effect, despite the apparent rational argument presented by Shefrin and Statman (1985); no empirical tests have been performed on the subject.

Implications of the disposition effect on trading profits and market efficiency

Effect on trading profits

It is proposed by Odean (1998a) that the tendency of investors to sell winning stocks and hold onto losing stocks results in suboptimal profits for investors. Odean (1998a) found that the stocks sold at a profit (realised gains) outperformed the losing stocks not sold by investors (unrealised losses) by 3.4 per cent in the year following the sale of the winning stock. This observation was confirmed by Chen et al. (2007) in China where stocks sold outperformed the replacement investments by 2.45

per cent, suggesting that the disposition effect-type trading of Chinese investors led them to make inferior investments after an irrational sale. Shumway and Wu (2006) also find that investors who exhibit the disposition effect the most in one period tend to have inferior investment returns in subsequent periods.

Trading literature identifies that irrational trading patterns as a result of behavioural biases can be costly to traders, and as a result traders should practice “disciplined” investment approaches, therefore minimising the risk of such costs being incurred. It is widely hypothesised that because professional investors have a need for continuing success and the costs associated with behavioural biases would hinder this, they follow the literary advice and become disciplined traders. If this were the case, given that the disposition effect is costly to investors (Odean, 1998a) and it is driven by behavioural factors, it is expected that professional traders would not exhibit the disposition effect to the same degree as individual investors, if at all. (Locke & Mann, 2000)

The disposition effect has been found to be displayed to varying degrees depending on the characteristics of the investor (Barber et al., 2007; Dhar & Zhu, 2002; Locke & Mann, 2000, 2003). Odean's (1998a) original observation of the disposition effect was based on individual investors, not professionals. Studies of the disposition effect in response to Odean's (1998a) paper in Israel (Shapira & Venezia, 2000), Finland (Grinblatt & Keloharju, 2001a), China (Feng & Seasholes, 2005), Australia (Brown et al., 2006), and Taiwan (Barber et al., 2007) all found the disposition effect to be in existence for both individuals and professional investors, although the extent to which each group of investors displayed the effect was not uniform.

Locke and Mann (2000) questioned the relevance of the disposition effect in modern markets if it is not displayed significantly by professional investors. Individual traders make up a fraction of the trading volumes in modern financial markets. They are therefore often referred to as “noise traders”: their effect on the market in terms of driving market prices is minimal, and is often overlooked as a result. If professional investors did not exhibit the disposition effect, there would be no effect on financial markets and the observation would be of little value. (Locke & Mann, 2000)

Locke and Mann (2000) sought to test this hypothesis and found that professional traders did exhibit the disposition effect. This has subsequently been confirmed by Chen et al. (2007) and Barber et al. (2007), showing that professional traders are not immune to the disposition effect. In a later paper, Locke and Mann (2003) found evidence to support the notion that trader discipline has predictive power when looking at future returns: increased trader discipline increases trader returns. It would therefore be expected that professional traders would exhibit the disposition effect to a lesser

extent. Consistent with this expectation, Dhar and Zhu (2002), Shumway and Wu (2006) and Chen et al. (2007) found that institutional investors were less affected by the disposition effect.

The reason for the difference in degree of the disposition effect displayed by professional investors relative to individuals was cited by Locke and Mann (2000) as being due to professionals following relatively more “disciplined” investment approaches. Dhar and Zhu (2002) expanded on this by proposing and confirming the proposition that the extent to which the disposition effect is exhibited by an investor depends on their sophistication with regards to financial markets and trading experience: more sophisticated and experienced traders were less likely to fall prey to the disposition effect.

Feng and Seasholes (2005) confirm the hypothesis of Dhar and Zhu (2002) in a robust test where trading experience and sophistication was found to all but eliminate the aversion to selling losses. However, in contradiction to Feng and Seasholes (2005), Chen et al. (2007) found that trading experience, as measured by how long a trader (professional or not) had been trading shares, was not a good predictor of the disposition effect.

The literature therefore shows that the cost associated with the disposition effect is being incurred by individual and professional investors alike. It is uncertain, however, as to why and to what extent professional investors display less of a disposition effect than individuals.

Market efficiency

Behavioural finance searches for explanations as to why, contrary to traditional finance theory, financial market participants do not always act rationally (Ritter, 2003). This is consistently observed to be the case and systematically irrational behaviour of financial market participants is a known feature of financial markets (Ritter, 2003). When such behaviour cannot be profited on by arbitrage traders, as discussed above, the effect of such irrational behaviour is to make financial markets informationally inefficient (Barberis & Thaler, 2003).

The disposition effect has implications for equilibrium prices in financial markets (Grinblatt & Han, 2002). Grinblatt and Han (2005) describe the theoretical implications of the disposition effect on market prices as follows: The irrational demand functions of investors subject to the disposition effect cause winning stocks to have undue selling pressure relative to losing stocks, causing the price of winning stocks to be understated and the price of losing stocks to be overstated relative to their true intrinsic values.

This implication of the disposition effect is more specifically linked to both under-reaction to news and stock price momentum.

Under-reaction to news

Under-reaction to news refers to the under-reaction of a share price as a result of new information becoming known in the market. This is explained as follows (Grinblatt & Han, 2005): in the event of good news for a share, the share price is expected to be driven up to its new intrinsic value by increased demand for the share. Because of the selling pressure experienced by winning stocks as a result of the disposition effect, good news prompts the realisation of gains by investors, resulting in the increase in share price from good news being suppressed. In the case of bad news for a share, the share price is expected to decrease through increased sales of that share. Because of the holding tendency for losing stocks, the volume of trades is not as high as is expected, resulting in an under-reaction to the bad news.

Investors are assumed not to be subject to the same degree of the disposition effect, however, as some investors will be in greater gain/loss making positions than others. This causes the share price to revert to its true intrinsic value over time as investors are pushed beyond the limits of the disposition effect (Grinblatt & Han, 2005). The slow movement of the share price to its true intrinsic value is referred to as post-announcement price drift (Frazzini, 2006).

The theory that the disposition effect causes an under-reaction to news is tested by Frazzini (2006) using data on mutual fund holdings. Frazzini (2006) proposes that the disposition effect will induce under-reaction to news in the short term, which in turn will lead to predictable returns and post-announcement price drift in the period after an unexpected news announcement. This is dependent on the information content of the news and the average gain or loss currently being held in the share. The result of the study shows that under-reaction to news is the most severe when the disposition effect predicts the largest under-reaction. Frazzini (2006) observed that shares with large unrealised capital losses underreacted only to bad news, and shares with large unrealised capital gains underreacted only to good news.

Stock price momentum

Stock price momentum, which refers to the persistence of stocks to move in one direction for between three months and a year, is an unexplained anomaly of financial markets (Grinblatt & Han, 2002). It was first identified by Titman and Jegadeesh (1993) where winning stocks, as measured based on the prior six months' returns, were identified to outperform losing stocks by about twelve per cent year on year (Grinblatt & Han, 2002). Grinblatt and Han (2005) propose that the disposition effect causes momentum in stock markets as explained above. Momentum is a longer term

observation than post-announcement drift, but is a result of the same market reactions to the disposition effect (Shumway & Wu, 2006).

Shumway and Wu (2006) sought to test whether momentum could be explained by the disposition effect using a sample of Chinese investors and firms. They confirmed, through a similar method to Frazzini (2006), that the disposition effect does drive momentum in the long run.

The literature therefore concludes that the disposition effect does affect market efficiency.

Conclusion

The disposition effect is an accepted norm of financial markets and investor behaviour on the part of both individual and professional investors. The reason for this behaviour is uncertain, however, and cannot be justified on the proposed rational grounds of tax considerations, future stock price performance expectations, rebalancing of portfolios to restore diversification and relative trading costs of winning and losing stocks. Behavioural finance theories are hence turned to in an attempt to explain the behaviour.

Prospect theory, mental accounting, regret and pride, overconfidence, self-attribution and self-control all contribute on some level to explaining the disposition effect. Prospect theory and overconfidence are the preferred explanations, although the exact reason that investors display this behaviour is uncertain.

The disposition effect has been used to justify observed market anomalies in the momentum and post-earnings price drift, and it is concluded that it does have an effect in creating market inefficiencies.

Method

Research Questions

The literature reviewed above concludes that the disposition effect has been observed to be a feature of investor behaviour in all of the markets in which it has been tested. Further, it is concluded that this behaviour cannot be explained on a rational basis.

This study aims to test for the disposition effect in a South African context for non-professional equity investors. Further, it aims to establish whether or not the assistance of professional guidance to a non-professional investor can reduce the extent to which the effect is displayed. If the disposition effect is observed, it will be investigated whether or not the effect can be explained based on rational grounds.

The following are the research questions for this study:

1. Do individual equity investors investing independently of professionals and in South African markets exhibit a disposition to sell winning stocks more readily than losing stocks? I.e., do South African non-professional individual investors exhibit the disposition effect?

The null hypothesis is that investors in South African equity markets do not have a disposition to sell winning stocks more readily than losing stocks. If this null hypothesis is rejected, three further research questions will be considered:

2. Does the advice of professional stockbrokers reduce the amount by which the disposition effect is exhibited?

The null hypothesis for this question is that there is no difference in the extent of the disposition shown when professional advice is introduced into the investment decision making process.

3. Do individual equity investors investing in South African markets have a higher propensity to sell losing stocks towards the end of the tax year of assessment?

The null hypothesis is that investors display the disposition effect to an equal extent throughout the year irrespective of the tax year end.

4. Can the anomalous behaviour be explained by the desire to rebalance portfolios?

The null hypothesis is that the desire to rebalance portfolios explains the tendency to sell winning shares ahead of losing shares.

Research questions 3 and 4 test whether the disposition to sell winners more readily than losers can be justified at all on rational grounds *viz.* tax liability optimisation and portfolio rebalancing. If the null hypotheses are rejected, it implies that the behaviour which leads to trading in line with the disposition effect is not justified on these rational grounds. In the absence of any other rational basis for the effect, it follows that the effect is irrational.

Research Approach

Odean (1998a)

The primary research question posed above (question 1) is identical to that posed by Odean (1998a); it tests for the existence of the disposition effect for independent, individual, non-professional investors in an equity market. Odean (1998a) showed that investors demonstrated a strong preference to realise gains ahead of losses in the US equity market context. The same method has been used to test for the disposition effect in Finland (Grinblatt & Keloharju, 2001b), the US (Dhar and Zhu, 2002), China (Feng and Seasholes, 2005), Australia (Brown et al., 2006) and Taiwan (Barber et al., 2007). Although other methods have been used to test for the disposition effect, Odean's (1998a) method is widely accepted as the benchmark test for the disposition effect. This method has therefore been chosen as the base method for this study.

Odean's (1998a) data consisted of 10 000 randomly selected customer accounts from a US discount brokerage house. The data detailed the trading activity of each customer over a six year period from January 1987 to December 1993. The data comprised 162 948 trades, with each record made up of an account identifier, the date of the trade, the security traded, a buy/sell indicator, the quantity traded, the commission paid, and the total amount of the transaction. Odean (1998a) also obtained information on share splits and dividends from the 1993 Centre for Research in Security Prices daily stock file for NYSE, AMEX and NASDAQ stocks.

Once the disposition effect had been observed in the data set, Odean (1998a) attempted to explain the behaviour on rational bases. Odean (1998a) tested four potentially rational explanations based on tax-liability optimisation, portfolio diversification, the expectation of future share price performance, and relative trading costs of winning and losing investments. Odean (1998a) concluded that none of these rational explanations held, and therefore concluded that the behaviour on the part of investors which resulted in the disposition effect was irrational. This study has been limited,

owing to data and computing constraints, to the consideration of tax-liability optimisation and portfolio diversification as rational grounds for the disposition effect (research questions 3 and 4 above).

Shapira and Venezia (2000)

The second question posed above is almost identical to that posed by Shapira and Venezia (2000) when attempting to ascertain if the disposition effect also holds for professional investors. Shapira and Venezia (2000) performed a test for the disposition effect for two different data sets, one data set containing trades by individuals in their own capacity and one data set containing trades by individuals executed with the assistance of professional portfolio and money managers. A comparison of the results between the two data sets showed that professional investors do display the disposition effect, but to a lesser extent when compared to individuals trading in their own capacity.

Shapira and Venezia (2000) used a different method to that used by Odean (1998a) and that used in this study (see below under “Research Method”) to test for the disposition effect. The difference lies in the focus of the calculation of the disposition effect being on investment holding durations versus realisation rates for gains and losses. The principle behind the test is very similar, however, and would generate the same results.

The data used by Shapira and Venezia (2000) consisted of a record of all the investment transactions executed by a sample of clients from one of the largest banks in Israel from January to December 1994. The data distinguished between the two types of customers analysed: those trading independently of professional advice (1 642 accounts), and those trading with the assistance of professional portfolio and money managers (2 688 accounts).

Research Strategy

The initial goal of this study was the replication of Odean's (1998a) US based study in a South African context. This required the sourcing of data similar in both nature and quantity to that used by Odean (1998a) from a South African source.

One of the largest stock brokers in South Africa was approached as a source of trade data. The selected company provides stock broking services for Johannesburg Stock Exchange (JSE) listed equity stocks, through both personal broker services and an online trading platform, and therefore has archived trade records for all trades executed for its clients.

The data requested from the broker was in the same format as that used by Odean (1998a): a record of all trades executed on behalf of the broker's customers for ordinary shares listed on the JSE, listing an account identifier (account number), the trade date, a security identifier (JSE ticker), a buy/sell indicator, the quantity traded, the commission paid and the price at which the security was traded. In addition to Odean's (1998a) data specifications, it was requested that both the accounts of "non-managed" customers (customers to whom no investment advice was provided, like those used by Odean (1998a)) and "managed" customers (customers to whom investment advice was provided by a professional adviser, like those used by Shapira and Venezia (2000)) be included in the sample data. The data was requested over a five year period from 31 October 2008 to 31 October 2013.

JSE share price data was required for the calculations of both realised as well as unrealised profits and losses. Daily high and low prices for every JSE listed ordinary share were retrieved for the observation period from the INET BFA database. Further market information was also required regarding corporate actions by JSE listed companies. This data was also sourced from the INET BFA database.

Research Method: The Data

The data received from the stock broker was not exactly the same as that initially requested owing to limitations imposed by the system from which it was drawn. The limitations resulted in two issues: first, two of the specific criteria requested regarding the trades were not adhered to (points (i) and (ii) below), and second, included in the data were extra trades which were not needed for the study (points (iii) and (iv) below). The issues were addressed as follows:

- i) The commission paid on each trade was not provided owing to the sensitivity of the data. The commission could not be manually calculated because the commission due depends on the type of account the investor holds with the broker and is therefore not uniform across all investors. Odean's (1998a) primary finding was that commissions did not have any effect on the disposition effect because it did not change the reference point from which investors calculated their gains and losses. Whilst being a limitation to the study, the absence of this information should not compromise the validity of the results.
- ii) Included in the data are trades executed by customers of the broker which are companies, and not only natural persons per Odean's (1998a) data. Of the accounts provided, it is estimated by the broker that about thirty per cent pertain to companies

and not to natural persons. Because of the nature of the data requested, accounts relating to companies are not individually identifiable from those relating to natural persons. It is therefore not possible to split out the results between the different types of investor. This will provide significant noise in the test for tax liability optimisation as the tax year end for companies is not set as February as it is for natural persons. This is identified as a limitation to the study and an area for further research.

- iii) Included in the data set were trades in instruments listed on the JSE which were not ordinary shares (for example preference shares and exchange traded notes). These trades were eliminated from the data-set.
- iv) Because the trades were drawn from the broker's internal system, there were internal trades between customer accounts and not with the JSE itself. Such trades arise when a trader requests the moving of shares from one account to another account with the same broker. Such trades are therefore do not entail an explicit decision to sell the stock, and were eliminated from the data set.

Before the tests for the disposition effect could be run, the data needed to be cleared of any inconsistencies, caused by the nature of financial markets, which could potentially skew the results. Two issues were considered: (i) the effect of corporate actions on investor positions, and (ii) the effect of stock purchases and sales not being at one price because of a lack of liquidity in the market.

- (i) Corporate actions: corporate actions could potentially result in a change in the number of shares held by an investor without a change in cash investment. This would skew the below test for the disposition effect as it would cause the average purchase price per share relative to the amount of shares held to be different. Four key types of corporate actions were considered: share splits, cash dividends, scrip dividends and capitalisation issues.

Share splits would impact the trade data by increasing the amount of shares held by the investor without any cash investment, resulting in the average price per share at the dates of purchase (see the application thereof under "research process" below) being incomparable to the selling price of a share after the share split. Share splits have been adjusted for by manually adjusting purchase prices and volumes prospectively for the share split. This enables the adjusted purchase price and amount of shares purchased to be compared meaningfully to the selling price (in the case of the profit or loss on a sale

being calculated) or the quoted price (in the case of the profit or loss on a paper position being calculated).

Scrip dividends and capitalisation issues would have the effect of increasing the number of shares held with no further investment, thereby enabling an investor to sell more shares than were originally purchased to exit a position. The value of a capitalisation issue and a scrip dividend should theoretically be added to the cost of a share. Cash dividends increase the total return earned by shareholders on their investment.

Consistent with Odean (1998a), however, scrip dividends, capitalisation issues and cash dividends will be ignored in terms of their effect on the selling price and cost price of an investment. Scrip dividends and capitalisation issues are excluded because investors are observed not to include notional expenditure in the reference point from which gains and losses are determined. Cash dividends are excluded because they are seen by investors as a separate source of income from the capital gain realised upon selling a share (Odean, 1998a).

- (ii) Market liquidity: the effect of a lack of market liquidity on trades would be to force an investor to accept more than one purchase price or selling price upon the decision to transact in the market. For example, if a shareholder were to sell a hundred shares, there may be buy offers for fifty shares at one price and fifty shares at a slightly reduced price. Such a transaction is not comprised of multiple transactions because of a conscious decision of the investor to sell at two prices, but rather a function of the characteristics of the market. The trades in such cases are therefore aggregated into one sale at the weighted average selling price, thereby reflecting the decision of an investor to sell their shares being counted as one sale and not more than one sale.

After the above cleansing, the data consisted of a full transaction history over five years across 23 941 accounts (14 550 non-managed and 9 391 managed). For the purposes of the tests for the disposition effect, only accounts for which there were at least two purchases and one sale over the period are considered. All accounts for which there were less than two purchases and one sale were removed from the data set.

The final data consists of 4 840 investor accounts and a total of 94 831 sales. Of the total accounts and sales, 3 275 accounts and 27 463 sales are non-managed. 1 565 accounts and 67 368 sales are

managed. Refer to Appendix 3A, Table 3.1 for a detailed breakdown of the data. The research process performed in order to answer the questions above using this data is discussed next.

Research Process

The research questions above are all co-dependent and rely heavily on the method used by Odean (1998a). First, the method to ascertain whether an investor displays the disposition effect is explained. This method is then applied to each of the research questions thereafter to independently address them.

Testing for the disposition effect

In testing whether or not an investor has a higher propensity to sell winning stocks ahead of losing stocks, it is not sufficient to merely compare the number of shares sold at a profit to the number sold at a loss. This is because the results would be skewed by the overall direction of the market. Consider the case where an investor is indifferent between selling winning and losing stocks: in an upward (downward) moving market, their portfolio would consist of more (fewer) winning shares than losing shares, and the investor will therefore tend to sell more winning (losing) shares despite having no bias toward doing so. In order to test for the disposition effect, the regularity with which investors sell winning stocks and losing stocks relative to their opportunities to do so must be evaluated. (Odean, 1998a). This is done as follows:

Each separate trading account is evaluated independently on a chronological basis. For every date within the sample period, a portfolio of shares is created. Only those shares for which the purchase date and price is known are included in the portfolio. As a result of this, at each date, a portfolio may only represent a portion of the investor's total portfolio. There may have been shares included in their account prior to the sample period for which the purchase date and price are unknown. The investor may also have investments in other accounts with other brokers which do not form part of this data set. Despite the fact that the test only looks at a portion of each investors total portfolio, it is unlikely that the data set will be biased toward an unusual tendency to realise gains and losses (Odean, 1998a).

For each portfolio, realised and paper gains and losses are calculated as follows:

Each time a sale takes place, the selling price for the share is compared to its weighted average purchase price to determine whether the sale was made at a profit or at a loss. This is referred to as a "realised" profit or loss.

For every other stock that is not sold but which forms a part of the portfolio at the beginning of a day, it is considered whether the position is a “paper” (unrealised) gain or loss, or neither. Paper gains and losses are determined by comparing the average purchase price of the stock to the high and low prices for that day. Paper gains are recorded when both the high and low prices for the day exceed the average purchase price of the stock. Paper losses are recorded when both the high and low prices for the day are less than the average purchase price of the stock. If the average purchase price falls between the high and low prices for the day, it is considered to be neither a paper gain nor loss, and is not counted.

Paper gains and losses are considered for every day throughout the sample period, regardless of whether or not there was any trading activity within the trading account concerned. Odean (1998a), being limited by computing resource constraints, only performed this calculation for days on which the sale of a stock occurred for an account. Barber et al. (2007) identified that the results per Odean's (1998a) method would be distorted by different portfolio sizes and therefore would not be comparable across investors. By calculating paper gains and losses daily, the issue of comparability of different portfolio sizes is eliminated (Barber et al., 2007).

The reference point from which gains and losses are calculated is an essential input into the above calculation. However, the reference point in itself is unknown as investors could consider a variety of prices to be the reference point relative to which they consider gains and losses: the original purchase price, the highest purchase price, the most recent purchase price, the weighted average purchase price, or even the highest price the share has reached since it was originally purchased. Consistent with the method used by Odean (1998a), the weighted average purchase price is used in this study as the reference point from which gains and losses are determined. Odean (1998a) found that the results of the test for the disposition effect were unaffected by which of the above options were chosen. Further, the weighted average purchase price was considered the most appropriate choice because cash expenditure has been concluded as being the most appropriate estimate as to what investors would consider the cost of their investment.

This method for evaluating the disposition effect is best illustrated by way of an example.

Consider an investor with a portfolio consisting of five stocks: A, B, C, D and E. Stocks A and B are worth more than the investor paid for them, while C, D and E are worth less. Suppose the investor were, in a four day period, to sell stock A on day 2, sell stock C on day 4, and execute no sales on the other days. On day 1, A and B are paper gains while C, D and E are paper losses. On day 2, A is a realised gain, B is a paper gain, while C, D and E are paper losses. On day 3, B is a paper gain while C,

D and E are paper losses. On day 4, C is a realised loss, while B is a paper gain, and D and E are paper losses. Realised gains, paper gains, realised losses and paper losses are summed for each individual account, and then across all accounts. Two ratios are then calculated:

$$\text{Proportion of Gains Realised (PGR)} = \frac{\text{Realised Gains}}{\text{Realised Gains} + \text{Paper Gains}}$$

$$\text{Proportion of Losses Realised (PLR)} = \frac{\text{Realised Losses}}{\text{Realised Losses} + \text{Paper Losses}}$$

In the example above, the investor has one realised gain, five paper gains, one realised loss and eleven paper losses. Therefore, applying the above formulae, $\text{PGR} = 1/6$ and $\text{PLR} = 1/12$. A significant difference between PGR and PLR indicates that an investor has a bias towards the sale of either gains or losses over the other. If PGR is significantly higher than PLR, the investor is concluded to have a propensity to sell winners and hold losers; behaviour which is consistent with the disposition effect.

Consistent with Odean (1998a) and the studies based on Odean's (1998a) study, statistical significance of the difference between PGR and PLR is ascertained through performing one-tailed z-tests for the sample aggregated in two different ways:

First, the independent incidents of realised and paper gains and losses are summed across all accounts to produce a sample-wide count of realised gains, realised losses, paper gains and paper losses. The PGR and PLR are then calculated for the sample as a whole. Statistical significance of the difference between PGR and PLR is established by calculating a z-statistic for the difference in the two proportions.

A z-test for the difference in proportions requires that the sampled individual observations used as inputs for the calculation of the z-stat (in this case, the number of paper and realised gains and losses) are independent, and that the sample size is large enough relative to one another to produce valid results. The minimum sample sizes for the second proportion relative to the first are determined based on the formulae derived by Fleiss, Levin and Cho Paik (2003).

The independence assumption for individual observations will not hold perfectly in the case of the disposition effect as the inputs to the calculation are not perfectly independent (Odean, 1998a). For example, an investor may choose not to sell the same stock on repeated occasions. It is highly

unlikely that the decision not to sell the stock on one day is entirely independent of the decision not to sell that same stock on another day. Such a lack of independence will inflate the test statistics, although it will not bias the observed proportions PGR and PLR. This is because the decision not to sell a winning stock on repeated occasions is offset by the decision not to sell a losing stock on repeated occasions (Odean, 1998a).

In order to control for the potential issue introduced by compromised independence, the second method for aggregating results is performed.

Second, the difference between PGR and PLR is calculated individually for each investor. The mean difference between PGR and PLR is then calculated across all investors in the sample. The mean difference is then tested for significance using a z-test, assuming the sample is normally distributed and the inputs are independent.

The second test introduces another potential issue regarding the independence of inputs. If two investors were motivated to either buy, sell or hold onto a stock because of the receipt of common information, their decisions would not be independent. The effect of this lack of independence on the test statistics is likely to be minimal, however (Odean, 1998a). This is cited as a limitation of the study.

Given the potential uncertainty regarding the independence assumption for each of the above tests, the difference between PGR and PLR is only accepted as significant if both tests conclude this to be the case at the stated level of certainty (Odean, 1998a).

How this method is applied to each of the research questions is explained next.

Do individual equity investors investing independently of professionals and in South African markets exhibit a disposition to sell winning stocks more readily than losing stocks?

Only the data pertaining to “non-managed” accounts is considered in answering this research question. The null hypothesis (H_0) to be tested is that independent investors do not have a propensity to sell winning stocks ahead of losing stocks ($PGR_{\text{non-managed}} \leq PLR_{\text{non-managed}}$). The alternative hypothesis (H_1) is that individual investors do sell winners ahead of losses, and therefore exhibit the disposition effect ($PGR_{\text{non-managed}} \geq PLR_{\text{non-managed}}$).

The above method is used to calculate PGR and PLR, both aggregated over the entire population and averaged across individual accounts. Statistical significance of the difference between PGR and PLR is

ascertained using the z-tests discussed above. A 5% significance level ($p = 0.05$) is deemed acceptable.

The z-test is only appropriate if two underlying assumptions about the data are met: (i) independence and (ii) distribution.

- (i) Independence: for both tests performed, the data is required to be independent. The limitation of independence is discussed above.
- (ii) Distribution: in the case of the z-test for the difference in proportions of PGR and PLR (the first test identified above), the sample must be of a “sufficiently large” size such that the central limit theorem will result in normally distributed inputs. The sample sizes for both PGR and PLR are well in excess of those proposed by Fleiss, Levin and Cho Paik (2003) given the significance level ($p = 0.05$) chosen for the study (see Appendix 3A, Table 3.2).

In the case of the z-test for the difference in mean PGR and PLR across all sampled investors, the distribution of PGR-PLR needs to be normally distributed. Given the sample size employed, application of the central limit theorem suggests that the distribution will be normal (Underhill & Bradfield, 2013). This is observed to be the case visually as illustrated in Appendix 3A, Figure 3.1.

The following research questions are dependent on it being found that independent investors do exhibit the disposition effect.

Does the advice of professional stockbrokers reduce the amount by which the disposition effect is exhibited?

Both the data pertaining to “non-managed” and “managed” accounts is considered in answering this research question. The null hypothesis (H_0) to be tested is that investors trading with the assistance of professional stockbrokers do not have a reduced propensity to sell winning stocks ahead of losing stocks when compared to individual investors ($PGR_{\text{managed}} - PLR_{\text{managed}} \geq PGR_{\text{non-managed}} - PLR_{\text{non-managed}}$). The alternative hypothesis (H_1) is that the investors trading with the assistance of professional stockbrokers show a reduced tendency to realise losses ahead of gains when compared to individual investors ($PGR_{\text{managed}} - PLR_{\text{managed}} < PGR_{\text{non-managed}} - PLR_{\text{non-managed}}$).

A two-step process is followed to answer this research question.

First, PGR and PLR is calculated for the data set filtered for “managed” accounts. Statistical significance of the difference between PGR and PLR is ascertained using the z-tests discussed above. A 5% significance level ($p = 0.05$) is deemed acceptable.

This is done to ascertain whether or not the disposition effect can be completely eliminated with the assistance of a professional stockbroker. If it is concluded that the disposition effect is not exhibited when investors are assisted by professionals, it can be concluded that the advice of professional stockbrokers has completely eliminated the disposition effect in individuals. There would therefore be no need for a second test. If, however, “managed” accounts still exhibit a disposition to sell winners ahead of losers, a second test is performed.

Second, a test for significance of the difference between the proportions PGR and PLR for “non-managed” and “managed” accounts is performed. Statistical significance of the difference between PGR and PLR for “non-managed” and PGR and PLR for “managed” accounts is ascertained using the same two z-tests for the difference in proportions discussed above. A 5% significance level ($p = 0.05$) is deemed acceptable.

The z-tests performed to ascertain statistical significance for this research question are only appropriate, as in the first research question, if the conditions of independence and distribution are satisfied. The independence assumption is still limited per the grounds identified above. The distribution assumption requires, as above, two characteristics. First, the sample must be “sufficiently large” so that the central limit theorem holds. This is confirmed to be the case when compared to the threshold proposed by Fleiss, Levin and Cho Paik (2003) given the significance level ($p = 0.05$) chosen for the study (see Appendix 3A, Table 3.2). Second, the differences between PGR and PLR for individual accounts is normally distributed. This is confirmed to be the case per a visual test, as shown in Appendix 3A, Figure 3.2.

Do individual equity investors investing in South African markets have a higher propensity to sell losing stocks as the tax year of assessment draws to a close?

For both non-managed and managed accounts (separately), the annual results of the above test for the disposition effect will be aggregated across investors and then disaggregated per month to show monthly results of PGR and PLR. South Africa’s tax year end for individuals is February (see Appendix 3B, Tables 3.3 and 3.4 for the data aggregated monthly). The null hypothesis (H_0) to be tested is that the propensity to sell winning stocks ahead of losing stocks is not smaller in February than in the rest of the year ($PGR_{\text{February}} - PLR_{\text{February}} \geq PGR_{\text{March to January}} - PLR_{\text{March to January}}$). The alternative hypothesis

(H_1) is that the propensity to sell winning stocks ahead of losing stocks is smaller in February than in the rest of the year ($PGR_{\text{February}} - PLR_{\text{February}} \leq PGR_{\text{March to January}} - PLR_{\text{March to January}}$).

To obtain the statistical significance of the result, a one tailed z-test for the difference in proportions PGR and PLR for February and for the rest of the year will be performed. A 5% significance level ($p = 0.05$) is deemed acceptable.

Performing a z-test for a difference in proportions requires that the data be independent, and that the sample be “significantly large”. The limitations of the independence of the data is the same for this test as is discussed above. The samples for “managed” and “non-managed” accounts are significantly large as confirmed by a comparison to the threshold proposed by Fleiss, Levin and Cho Paik (2003) given the significance level ($p = 0.05$) chosen for the study (see Appendix 3B, Table 3.5).

Can the anomalous behaviour be explained by the desire to rebalance portfolios?

To control for the rational desire to rebalance portfolios, the data set is filtered so that only sales of entire positions in a stock are included (see Appendix 3C, Table 3.6 for a breakdown of the data-set containing sales of an entire position only). A sale to rebalance a portfolio would most likely be a partial sale, not a whole sale (a whole sale refers to a sale of an entire position). By including only whole sales, the possibility of rebalancing is eliminated as a cause for the disposition effect. Were investors still to display a disposition to sell winners ahead of losers when only whole sales are considered, it can be concluded that the disposition effect is not explained by the rational desire to rebalance portfolios. Consistent with the initial criteria for the sample as a whole, only those accounts for which there were at least two purchases and one sale over the sample period are included in the “whole sales” sample.

Both “non-managed” and “managed” accounts will be considered in answering this research question. The null hypothesis (H_0) is that investors do display a propensity to realise gains ahead of losses when only sales of entire positions are considered ($PGR_{\text{whole sales}} \geq PLR_{\text{whole sales}}$). The alternative hypothesis (H_1) is that investors do not display a propensity to realise gains ahead of losses when only sales of entire positions are considered.

Statistical significance of the difference between PGR and PLR is ascertained using the z-tests discussed above. A 5% significance level ($p = 0.05$) is deemed acceptable.

The z-tests are only appropriate if both the independence and distribution assumptions about the data are met. The independence issue identified above still holds for the data set filtered for whole

sales only. The distribution of the data for each test needs to be reconsidered for the data set filtered for whole sales only.

For the z-test for the difference in proportions of PGR and PLR (the first test identified above), the sample must be of a “sufficiently large” size such that the central limit theorem will result in normally distributed inputs. The samples for “managed” and “non-managed” accounts are sufficiently large as confirmed by the comparison to the threshold proposed by Fleiss, Levin and Cho Paik (2003) given the significance level ($p = 0.05$) chosen for the study (see Appendix 3C, Table 3.7).

In the case of the z-test for the difference in mean PGR and PLR across all sampled investors, the distribution of PGR - PLR needs to be normally distributed. Given the sample sizes employed, application of the central limit theorem suggests that the distributions will be normal (Underhill & Bradfield, 2013). This is observed visually to be the case as is illustrated in Appendix 3C, Figures 3.3 and 3.4.

Ethics

The data requested for this study from the stockbroker was deliberately void of any personal information relating to the underlying clients who had ordered the trades. The account number provided for each trade is untraceable to any individual in any way. This was done so that at no point could the personal information of a client (their trades) be traced back to them. The results of this study are therefore void of any ethical issues.

Limitations/Risks

This study does not take into account the effect of trading costs on the behaviour of investors. In previous studies, commissions paid have been factored into the calculation of paper and realised gains and losses. Because of the variable structure of commissions charged by the brokerage used, it is impossible to predict what the commissions would have been on each purchase and sale of shares. Odean (1998a) found, however, that trading costs did not affect the conclusion regarding investors’ disposition to sell winners ahead of losers: regardless of the inclusion of transaction costs, investors’ were still found to exhibit the effect. This limitation is therefore unlikely to have a significant effect on the results of this study.

A further limitation of the data is that included in the data are trades for accounts owned by both natural persons and companies. These two types of investor cannot be differentiated in the data. In South Africa, the tax year end of a company coincides with the company’s chosen financial year end, resulting in companies’ tax years not always ending in February (as is hypothesised in the research question). Because the tax year end for companies is not uniform, the investigation into the extent

of the disposition effect as the tax year for natural persons draws to a close will not generate clear results.

This constraint on the tax related research question will not render the results invalid, however. Only thirty per cent of accounts included in the data set pertain to companies. Further, company tax year ends are not concentrated in particular months over others because South African companies can choose their tax year end (Page and Way, 1993). This results in the expectation that, were tax motivated trading to affect the extent of the disposition effect, the aggregated observations of the extent of the disposition effect observed per month for companies will not be biased toward any particular month. The overall observations relating to the extent of the disposition effect over the natural persons tax year will therefore not be influenced toward any month in particular because of the inclusion of companies in the data. The results of the testing will therefore be diluted and less concrete, but still valid.

As noted above, the independence assumption for the z-tests performed is not clearly satisfied. The results of the statistical testing will therefore be inflated (Odean, 1998a). This limitation is reduced to a minimum by performing two separate tests for significance of the results, and by only rejecting the null hypotheses tested if both of the tests agree. This is therefore not likely to have a significant effect on the results.

Results

The following table, extracted from Appendix 4, summarises the results for the first two research questions discussed below.

Table 4.1: The disposition effect for managed and non-managed accounts

	Non-managed accounts		Managed accounts	
	Overall	Average per account	Overall	Average per account
PGR (%)	3.08	8.11	8.02	6.95
PLR (%)	2.03	4.31	7.84	3.85
Difference (PGR-PLR) (%)	1.05	3.80	0.18	3.10
PGR/PLR	1.51	1.88	1.02	1.81
% investors where PGR>PLR	-	73.50	-	75.34
z-stat	- 32.30	- 13.09	- 2.94	- 8.65
Significance	$p < 0.01$	$p < 0.01$	$p < 0.01$	$p < 0.01$
Accept/reject H_0 at 1% level	Reject	Reject	Reject	Reject
Z-stat for difference between managed and non-managed = - 12.40, therefore reject H_0 at 1% level.				

Do individual equity investors investing independently of professionals and in South African markets exhibit a disposition to sell winning stocks more readily than losing stocks?

The null hypothesis for this research question is rejected at the 5% level ($p < 0.0001$) based on both z-tests performed (refer to Appendix 4, Table 4.1 for a detailed breakdown of the results of the tests performed). It is therefore concluded that individual equity investors investing independently of professionals and in South African markets exhibit a disposition to sell winning stocks more readily than losing stocks. This result is consistent with the findings of the tests performed for the disposition effect elsewhere in the world by Odean (1998a) in the United States of America, Shapira and Venezia (2000) in Israel, Grinblatt and Keloharju (2001b) in Finland, Feng and Seasholes (2005) in

China, Brown et al. (2006) in Australia, Barber et al. (2007) in Taiwan and Prosad et al. (2013) in India.

Of the 3 275 individual accounts tested for the disposition effect, investors were on average more than 85% more likely to realise a gain than a loss ($PGR/PLR = 1.88$). When gains and losses are aggregated across investors, the sampled investors were more than 50% more likely to realise a gain than a loss ($PGR/PLR = 1.52$). These statistics are consistent with those reported by Odean (1998a) in the US and Barber et al. (2007) in Taiwan, indicating that South African investors exhibit the disposition effect to as great an extent as individual investors in other international markets. The extent to which the disposition effect is shown therefore appears to be independent of the equity market in which the investors trade.

The difference between the averaged proportions (i.e. the average of PGR/PLR for each individual investor) and aggregated proportions (i.e. PGR and PLR calculated by summing all gains and losses across all investors and then calculating the proportions) of PGR to PLR are because of two reasons: first, they differ because of the variation in size of accounts over time, with the size of accounts being measured in terms of the amount of open positions at any time. Larger accounts which have been open for longer periods of time hold more weight than smaller accounts open for shorter periods of time. Second, they differ because of the varying trading frequency, measured in terms of sales relative to opportunities to sell, of accounts and their relative weights in the data set.

Does the advice of professional stockbrokers reduce the amount by which the disposition effect is exhibited?

It is concluded at a 5% ($p < 0.001$) level that individual equity investors in South Africa acting with the assistance of professional stockbrokers do exhibit a disposition to sell winning stocks more readily than losing stocks (refer to Appendix 4, Table 4.1 for a detailed breakdown of the results of the tests performed). This is consistent with the findings of Shapira and Venezia (2000). The disposition effect is therefore not eliminated as a result of assistance from professional stockbrokers.

Of the 1 565 individual accounts analysed, individual investors were on average more than 80% likely to realise gains than losses ($PGR/PLR = 1.81$). When gains and losses are aggregated across investors, however, the sampled investors were only 2% more likely to realise gains than losses ($PGR/PLR = 1.02$) (note that the reason for the difference between the average PGR/PLR at an account level and that at an aggregated level is the same as that identified when discussing the results of the first research question above).

The observation that traders are on aggregate just 2% more likely to realise gains than losses shows that the propensity to realise gains ahead of losses, although significant, is not nearly as big for those investors acting with the assistance of professional stockbrokers. This observation is confirmed statistically at the 5% level: the null hypothesis that investors trading with the assistance of professional stockbrokers do not display a reduced propensity to realise gains ahead of losses is rejected ($p < 0.0001$). It is therefore concluded that the advice of professional stockbrokers, despite not eliminating the disposition effect, does reduce the amount by which the disposition effect is exhibited by individual investors in South Africa. This finding is consistent with that of Shapira and Venezia (2000).

The relative trading frequency of “managed” and “non-managed” accounts could potentially be cited as a reason for the difference in their propensity to realise gains ahead of losses. This would therefore attribute the reduced disposition shown by “managed” accounts to relative trading activity of the account classes, and not to the professional advice provided. This is investigated further under “Analysis of Results”.

Do individual equity investors investing in South African markets have a higher propensity to sell losing stocks as the tax year of assessment draws to a close?

The following table, extracted from Appendix 4, summarises the results for the research question discussed below.

Table 4.2: The extent of the disposition effect by month

	Non-managed	Managed
PGR		
- February	2.83%	7.95%
- March to January	3.10%	8.02%
PLR		
- February	2.33%	7.52%
- March to January	2.01%	7.86%
PGR - PLR		
- February	0.50%	0.43%
- March to January	1.09%	0.16%
z-stat for difference	-4.78	1.19
Significance	$p < 0.01$	$p < 0.89$
Accept/reject H_0 at 1% level	Reject	Accept

Non-managed accounts:

For non-managed accounts, the null hypothesis is rejected at a 5% level ($p < 0.01$) (refer to Appendix 4, Table 4.2 for a detailed breakdown of the results of the test performed). It is therefore concluded that investors investing independently of professionals do have a reduced propensity to realise gains ahead of losses as the tax year of assessment draws to a close. This suggests that investors acting independently of professional stockbrokers do engage in tax motivated trading toward the end of the tax year. This finding is consistent with that of Odean (1998a).

Figure 4.1 in Appendix 4 graphs the ratio of PGR to PLR for each month, starting in March, the beginning of the South African tax year, and ending in February, the end of the tax year. It is expected that the ratio of PGR to PLR would be the lowest in February, and that there would be a consistent decline in the ratio as the year progresses towards the tax year end (Constantinides, 1983). The graph shows that, although the propensity to realise gains is the lowest in February, the propensity does not show a steady downward trend towards the tax year end as was observed by Odean (1998a), Grinblatt and Keloharju (2001a) and Poterba and Weisbenner (2001). Further, February is only marginally the month with the lowest ratio of PGR to PLR with June, a month which is insignificant when considering the tax year, a close second (February PGR/PLR = 1.2, June PGR/PLR = 1.28). Justifying the lower relative propensity to realise gains ahead of losses in February on tax-motivated trading is therefore inappropriate in a South African context.

Managed accounts:

For managed accounts, the null hypothesis is accepted at a 5% level ($p < 0.89$) (refer to Appendix 4, Table 4.2 for a detailed breakdown of the results of the test performed). It is therefore concluded that investors investing with the assistance of professionals do show a reduced propensity to realise gains ahead of losses as the tax year of assessment draws to a close.

Figure 4.2 in Appendix 4 graphs the ratio of PGR to PLR for each month, starting in March and ending in February. The graph shows no definitive trend as the tax year progresses, contrary to the expectation for the tax motivated trading proposed by Constantinides (1983) and the expectation implied by the rejection of the null hypothesis above. It is therefore concluded that investors investing with the assistance of professionals do not conform to any tax motivated trading patterns despite it being optimal to do so. This is most likely because investment advisors receive commissions based on pre-tax returns earned by clients, and are therefore not incentivised to maximise post-tax returns.

The results of this test for both types of investors show that the disposition effect is not reduced as a result of tax-motivated trading behaviour. The extent of trading consistent with the disposition

effect cannot therefore be explained based on rational tax-motivated trading behaviour. The relevance of these results is however limited by the inclusion of trading accounts held by companies and not only natural persons (as was stated above under “Limitations/Risks”).

Can the anomalous behaviour be explained by the desire to rebalance portfolios to restore diversification?

The following table, extracted from Appendix 4, summarises the results for the research question discussed below.

Table 4.3: The disposition effect for “non-managed” and “managed” accounts when controlled for portfolio rebalancing

	Non-managed accounts		Managed accounts	
	Overall	Average per account	Overall	Average per account
PGR (%)	1.16	5.24	0.72	4.64
PLR (%)	0.85	2.83	0.72	2.92
Difference (%)	0.31	2.41	0.008	1.72
% investors where PGR>PLR	-	70.00	-	69.99
z-stat	- 14.08	- 8.57	- 0.31	- 4.39
Significance	p < 0.01	p < 0.01	p < 0.38	p < 0.01
Accept/reject H₀ at 1% level	Reject	Reject	Accept	Reject
Z-stat for the difference between non-managed and managed = - 9.97, therefore reject H₀ at 1% level.				

Non-managed accounts:

The null hypothesis for this research question is rejected at the 5% level ($p < 0.0001$) based on both z-tests performed (refer to Appendix 4, Table 4.3 for a detailed breakdown of the results of the tests performed). It is therefore concluded that the rational trading behaviour related to rebalancing of portfolios does not explain the propensity of individual equity investors investing independently of professionals and in South African markets to sell winning stocks more readily than losing stocks. This result is consistent with the findings by Odean (1998a).

Of the 2 406 individual accounts tested for rebalancing as an explanation for the disposition effect, investors were still on average more than 85% more likely to realise a gain than a loss (PGR/PLR = 1.85). When gains and losses are aggregated across investors, the sampled investors were more than 35% more likely to realise a gain than a loss (PGR/PLR = 1.36).

Managed accounts:

For managed accounts, the null hypothesis is rejected at the 5% level ($p < 0.001$) when performing the z-test for the average PGR minus PLR across all accounts, but is accepted at the 5% level ($p < 0.38$) when the results of the test are based on gains and losses aggregated across investors (refer to Appendix 4, Table 4.3 for a detailed breakdown of the results of the tests performed). Based on the requirement that both statistical tests disprove the null hypothesis at the 5% level in order to reject it, the null hypothesis cannot be rejected at the 5% level. The results therefore infer that trading behaviour by investors investing with the assistance of professionals, which is observed to be consistent with the disposition effect, could be explained by the rational motive to rebalance their investment portfolio.

Of the 1 068 individual accounts tested with only whole sales included, individuals acting with the assistance of professional stockbrokers were, on average, more than 55% more likely to realise gains than losses ($PGR/PLR = 1.59$). When the accounts were aggregated, however, investors were just under 1% more likely to exhibit the disposition effect ($PGR/PLR = 1.01$). The reason for the difference between when accounts are averaged and when the results are aggregated across all accounts, as was the case with the entire data set, is because of the relative size and trading frequency of accounts. The reasons behind this conclusion are considered next.

Analysis of results

Based on the research questions addressed above, the following conclusions are drawn:

- i) Individual investors, acting both in their own capacity and with the assistance of professionals do show a propensity to realise gains ahead of losses in a South African context.
- ii) When individual investors are advised by professional stockbrokers, they show a reduced propensity to realise gains ahead of losses.
- iii) Individual investors in South Africa, acting both in their own capacity and with the assistance of professionals, show a reduced propensity to realise gains ahead of losses in February, the last month of the South African tax year. The results of this test do not conclusively show, however, whether or not the trading is tax motivated or not. The extent of trading consistent with the disposition effect cannot be explained by rational tax-motivated trading.
- iv) When trading consistent with portfolio rebalancing is eliminated, “non-managed” accounts still exhibit the disposition effect. “Managed” accounts, however, no longer display a propensity to sell gains ahead of losses, implying that the propensity to sell

winners ahead of losers by investors under the guidance of professionals can be justified on rational grounds and is therefore not a behavioural irregularity.

The above conclusions can be unpacked further so as to fully understand the implications and validity of the results. This is explored next.

The effect of trading frequency on the comparability of account classes:

The validity of the comparison of the data relating to “non-managed” and “managed” accounts may be compromised because of relative trading activity of the two types of accounts. Relative to the total amount of paper positions, “managed” accounts have significantly more sales than “non-managed” accounts (refer to Appendix 3A for a detailed breakdown of paper positions and sales between each account type). It is expected that a difference in relative trading frequency between two accounts would change the size of PGR and PLR. An account with more trades relative to their opportunities to trade than another account would show higher ratios for PGR and PLR, and therefore a greater difference between the two ratios.

The second research question above tests for significance of the difference between the difference of PGR and PLR for each of “non-managed” and “managed” accounts. The conclusion drawn, that “non-managed” accounts have a greater propensity to realise gains ahead of losses than “managed” accounts, assumes that the data between the two account types are comparable. Were this not to be the case, the conclusion would be invalid, and it could not be concluded that the advice of professional traders reduces the disposition effect.

To assess the effect on the research questions above of differing trading frequency between account types, an analysis of the effect of trading frequency on the disposition effect is performed. For each account, both managed and non-managed, a “frequency index” is calculated for the time period as a whole by dividing the sum of all sales (both at a profit and at a loss) by the sum of all paper positions and sales. The frequency index therefore shows how many sales an investor executed relative to their opportunities to do so.

Each account in the two separate data sets for “managed” and “non-managed” is ranked based on the attributed frequency index value. The accounts in each data set are then split up into ten equal buckets based on their relative trading frequency. Table 5.1 and 5.2 in Appendix 5: “Analysis of results” show the breakdown of each bucket per data group. The data is further summarised in Figure 5.1.

As expected, the PGR and PLR increase with the frequency index buckets (bucket 1 relates to the highest frequency of trades, bucket 10 the lowest). This confirms that the PGR and PLR ratios, as well

as the difference between the two ratios, increase with the amount of sales relative to the opportunities to do so.

The frequency index for “non-managed” accounts in total is 0.03. The frequency index for “managed” accounts in total is 0.08. “Managed” accounts therefore trade more frequently (almost three times more) relative to their opportunities to do so than “non-managed” accounts. It would therefore be expected, based on the relative frequency of trades, that the difference between PGR and PLR would be greater for “managed” accounts. This would skew the comparison between the difference between PGR and PLR for the two types of account as “managed” accounts should have a greater difference not as a result of their propensity to realise gains ahead of losses, but because of their relative trading frequency.

The research question above, however, concludes at the 5% level that the difference between PGR and PLR is greater for “non-managed” accounts than for “managed” accounts. This conclusion is therefore further reinforced by the result that the actual difference between PGR and PLR for the two account types is the opposite of that proposed by their relative trading frequencies.

It is therefore concluded that the relative trading frequency of the two account types strengthens the validity of the conclusion regarding the extent of the disposition effect showed by the two account types. The reduced propensity for individuals investing with the assistance of professionals is not as a result of the inherent differences in data attributable to each account type and can therefore be attributed to the professional advice provided.

The reduction of disposition effect-type behaviour as a result of professional assistance:

The second research question above finds that the extent to which investors display the disposition effect is reduced when individual investors are assisted by professional stockbrokers. This is consistent with the observation by Dhar and Zhu (2002), Shumway and Wu (2006) and Chen et al. (2007) who all found that institutional investors were less affected by the disposition effect.

The reason cited by Locke and Mann (2000) for the difference in degree of the disposition effect displayed by professional investors relative to individuals is that professionals follow relatively more “disciplined” investment approaches. In the case of “managed” accounts used for this study, account holders are required to agree on an investment mandate with their advisor at the inception of the account. This mandate is then used as a guideline for all investment decisions made by the investor, in conjunction with the advisor, for the account. The investment mandate introduces discipline to the investment approach as it pre-defines what assets and limits an investor is prepared to invest in. This is decided on before the investor is confronted with emotional decisions induced by relative

profit and loss positions which may cause irrational behaviour consistent with the disposition effect. Irrational behaviour is therefore actively reduced by professional assistance. This is observed in the reduced disposition displayed by “managed” accounts.

The conclusion that professional investors show a reduced disposition effect as a result of their “disciplined” investment approaches is however contradicted by the findings of the fourth research question. Trading behaviour consistent with rebalancing of portfolios is an example of disciplined behaviour as strict investment mandates are being adhered to through rebalancing. The fourth research question finds that such trading increases the disposition effect: when trading associated with rebalancing is eliminated, the disposition effect is removed from “managed” accounts. Rebalancing in line with “disciplined” investing is therefore a contributing factor to the disposition effect, albeit a rational contributor.

The overall conclusion is that individual investors display less of a disposition to realise gains ahead of losses when assisted by professionals. Given the costs associated with realising gains ahead of losses as shown by Chen et al. (2007) and Odean (1998a), before the consideration of fees, investing with the assistance of a professional advisor will increase investor returns.

Observable trading characteristics driving the disposition effect:

Based on the results generated in this study, two potential contributing factors driving the disposition effect have been identified: trading frequency and portfolio size over time. Comparison of these factors to the extent of disposition shown would be best analysed statistically by calculating a measure of correlation between the extent of the disposition effect per account and an individual statistic representing frequency and size.

This is not possible for this data set. As done by Brown et al. (2006), the PGR/PLR ratio would be used as the best proxy for extent of disposition effect shown by an individual account. Included in the data used in this study, however, is a large amount of accounts for which either PGR or PLR are zero (because of zero trades at a gain or loss respectively). This results in the ratio of PGR to PLR not reflecting the degree of disposition between accounts: when PGR is zero but PLR is a number, the PGR/PLR ratio will be zero despite the individual having a higher propensity to realise losses than gains. Conversely, when PGR is a number but PLR is zero, PGR/PLR is undefined despite the individual having a higher propensity to realise gains than losses.

A further limitation of the output data used in this study is that size and time are reflected in one metric: the number of paper gains and losses. If an account has many open positions at once, it will show a larger amount of daily paper positions relative to an account with fewer open positions.

Further, if an account is open for a longer period of time during the five years under review, it will have comparatively more open positions than an account of similar size which was open for a shorter period of time. The relationship between the disposition effect and account size is recommended as an area for future research (see below).

There is value in analysing trading frequency, however, as it can provide a benchmark for future study. Given the limitations identified, the effect of trading frequency on the extent of the disposition effect is analysed on an aggregated, visual basis.

Trading Frequency:

As was done above, trading frequency is compared across investors by creating a “frequency index”. The frequency index is calculated for each account by dividing the sum of all sales (both at a profit and at a loss) by the sum of all paper positions and sales. It therefore shows how many sales an investor executed relative to their opportunities to do so.

As was done above, each account is ranked based on its frequency index, and grouped into 10 buckets based on rank. Bucket 1 reflects the highest frequency index. The frequency index and the ratio of PGR/PLR is then calculated for each bucket.

Figure 5.3 graphs the ratio of PGR/PLR per frequency index bucket for both managed and non-managed accounts. For both “non-managed” and “managed” accounts, there is a marginal improvement of PGR/PLR as trading frequency is reduced, suggesting that trading frequency is positively correlated to the extent of the disposition effect. The link between trading frequency and the disposition effect is, however, questionable, and is recommended as an area for future research (see below).

Conclusion

Individual investors, acting both in their individual capacity and when acting under the guidance of professionals, display a propensity to realise gains ahead of losses in a South African context. The extent to which this propensity is shown is reduced by the assistance of professional investors, showing that there is value to be derived by individual investors in employing the assistance of professionals.

The reason for the exhibition of the disposition effect by individual investors investing independently of professional advice is unexplained based on the rational grounds of portfolio rebalancing. In the absence of other rational justification for the disposition effect, this trading behaviour is concluded to be irrational and behaviourally driven.

Although the disposition effect is exhibited by investors investing with the assistance of professionals, the propensity to realise gains ahead of losses is eliminated when trading consistent with rebalancing portfolios is excluded. It is therefore concluded that the disposition effect shown by such investors is as a result of the rational, disciplined trading decisions consistent with rebalancing portfolios. The disposition effect is therefore concluded to be rational on the part of investors acting with the assistance of professionals.

Tax motivated trading is found not to be conclusively evident in either individual investors acting in their own capacity or those acting with the assistance of professionals. Analysis of the extent of the disposition effect displayed over the tax year concluded that the justification of an observed reduction of the disposition effect in certain months of the year cannot therefore be justified based on rational tax-motivated trading. This potential rational explanation for the extent of the disposition effect fails to predict the effect.

The underlying behavioural cause for the disposition effect in individual investors acting independently of professionals is unknown. The behaviour cannot explicitly be linked to trading frequency or size and duration of portfolios due to limitations inherent in the data set used for this study.

In conclusion, individual investors acting independently of professionals in South Africa do show a disposition to sell winning stocks ahead of losing stocks. This propensity can be reduced through the employment of professional assistance. The reason for the behaviour consistent with the disposition effect is, however, unknown.

Conclusion

Summary of results

It is concluded with high statistical significance that individual investors, acting both in their own capacity and acting with the assistance of professionals, do exhibit a propensity to realise gains ahead of losses. This trading is consistent with the disposition effect. It is therefore concluded that individual investors display the disposition effect in a South African context.

Limited evidence of tax motivated trading is found to exist in South African individuals: across the entire financial year, investors showed a greater propensity to realise gains ahead of losses. This observed trading behaviour is not consistent with post-tax return maximisation. Tax motivated trading is not differential between individuals acting in their own capacity and individuals acting with the assistance of investment professionals.

When investing consistent with rebalancing of portfolios is controlled for, individual investors acting in their own capacity were still found with statistical significance to exhibit the disposition effect. Individual investors acting with the assistance of professionals are found not to display a disposition effect any longer when trading consistent with rebalancing was controlled for.

Conclusion

The disposition effect is displayed by individual investors in South African markets, both when acting in their own capacity and when acting under the guidance of professional investors. Investors acting under the guidance of professional investors do, however, show a reduced propensity to realise gains ahead of losses. This reduction in the disposition effect is attributed to the professional investing advice offered to individual investors.

South African investors showed limited evidence of tax motivated trading, both when acting in their own capacity and when acting under the guidance of professional investors. Rational tax-motivated trading fails to predict the disposition effect in South Africa.

It is therefore concluded that individual investors display sub-optimal trading characteristics, both in the form of a disposition effect and poor tax motivated trading strategies. The negative effects associated with such trading are, however, reduced through the employment of professional investor advice.

Recommendations and areas for further research

This dissertation is the first piece of literature testing for the disposition effect in South African markets. The confined scope of this paper gives rise to many areas in which further research could be performed, both to add to the validity of the conclusions of this dissertation, as well as to add to the world-wide literature on the disposition effect.

This dissertation is based upon a sample of trades limited to one stockbroker in South Africa. Further, the stockbroker grew significantly over the period under observation, resulting in there being a relatively short observation period for accounts opened toward the end of the five year sample period. It is possible, given the limited portion of the investor population in South Africa which is sampled, that the results presented above are not representative of non-professional South African investors as a whole. The validity of the conclusions could be improved through a similar study based on a sample sourced from multiple investment houses over a longer time period. This would allow for greater generalisations of conclusions regarding the disposition effect in South Africa.

The inclusion of transaction costs is important to the strength of the conclusions regarding the disposition effect in South Africa. This is particularly true for the differentiation of “non-managed” and “managed” accounts because the transaction costs incurred by each type of account are not uniform: “managed” accounts incur higher transaction fees as a result of the added services received from their investment advisors. This could be a potential reason that “managed” accounts showed a reduced propensity to realise gains ahead of losses than non-managed accounts. Further investigation into the effect of transaction costs on the disposition effect in South Africa is therefore required. This would allow for some form of quantification of the disposition effect after consideration of transaction costs, therefore allowing for a more conclusive comparison between “managed” and “non-managed” accounts.

This dissertation differentiates “managed” and “non-managed” on the basis that investors within the one group receive investment advice from professionals, whereas the other group does not. The group of investors which receive investment advice can be broken down further for a more detailed conclusion as to the benefits of professional advice. For all “managed” accounts, an investment mandate is agreed upon between the investor and the professional advisor. The extent to which the investor is involved in further investment decision making is, however, not uniform. Further stratifying of the “managed” group could result in more specific conclusions as to how individual investors can minimise the disposition effect.

This dissertation is limited to individual, non-professional investors in South Africa. Research into the effects of the disposition effect on South African market efficiency is therefore not possible based on this data set alone. Further research is required as to whether professional investors also display the disposition effect in South Africa and to what extent they display the effect. Research can then be focused on the effects of the disposition effect on market efficiency in South Africa.

This dissertation was limited in its conclusion regarding tax liability optimisation and the disposition effect due to the inclusion of companies in the data tested. The conclusion regarding the link between the disposition effect and tax motivated trading can be strengthened through the testing of a sample compiled entirely of individuals with the same tax year end.

Given the conclusion that South African investors do exhibit the disposition effect, investigation into why they display the disposition effect can be performed. Investigation into the expectation of future stock price performance as well as relative trading costs of profit and loss making investments, as investigated by Odean (1998a), can be performed. Further, investigation into the link between the disposition effect and trading volumes and portfolio size can be performed. Finally, behavioural drivers of the disposition effect can be investigated.

Bibliography

- Andreassen, P. B. (1988). Explaining the price-volume relationship: The difference between price changes and changing prices. *Organizational Behavior and Human Decision Processes*, 41(3), 371–389.
- Barber, B. M., Lee, Y.-T., Liu, Y.-J., & Odean, T. (2007). Is the Aggregate Investor Reluctant to Realise Losses? Evidence from Taiwan. *European Financial Management*, 13(3), 423–447.
- Barber, B. M., & Odean, T. (2000). Trading Is Hazardous to Your Wealth : The Common Stock Investment Performance of Individual Investors. *The Journal of Finance*, LV(2), 773–806.
- Barber, B. M., & Odean, T. (2001). Boys will be boys: gender, overconfidence, and common stock investment*, *The Quarterly Journal of Economics*, 261-292.
- Barber, B. M., & Odean, T. (2003). Are individual investors tax savvy? Evidence from retail and discount brokerage accounts. *Journal of Public Economics* 1 (2003) 000–000, 1-25.
- Barberis, N., & Thaler, R. (2003). A Survey of Behavioural Finance. *Handbook of the Economic of Finance*, 1052–1121.
- Barberis, N., & Xiong, W. E. I. (2009). What Drives the Disposition Effect ? An Analysis of a Long-Standing Preference-Based. *The Journal of Finance*, LXIV(2), 751–784.
- Ben-David, I., & Doukas, J. A. (2006). Overconfidence, Trading Volume, and the Disposition Effect: Evidence from the Trades of Institutional Investors. *Working Paper February 2006*, 1-14.
- Brown, P., Chappel, N., Da Silva Rosa, R., & Walter, T. (2006). The Reach of the Disposition Effect : Large Sample Evidence Across Investor Classes. *International Review of Finance*, 6(1-2), 43–78.
- Butler, A., & Highhouse, S. (2000). Deciding to sell: The effect of prior inaction and offer source. *Journal of Economic Psychology*, 21, 223–232.
- Chen, G., Kim, K. A., Nofsinger, J. R., & Rui, O. M. (2007). Trading Performance, Disposition Effect, Overconfidence, Representativeness Bias, and Experience of Emerging Market Investors. *Journal of Behavioural Decision Making*, 20(February), 425–451.
- Constantinides, G. M. (1983). Capital Market Equilibrium with Personal Tax. *Econometrica*, 51(3), 611–636.

- Constantinides, G. M. (1984). Optimal Stock Trading with Personal Taxes. *Journal of Financial Economics*, 13, 65–89.
- Dhar, R., & Zhu, N. (2002). Up Close and Personal: An Individual Level Analysis of the Disposition Effect (Vol. 52). *Yale ICF Working Paper No. 02-20*, 1-37.
- Fama, E. (1970). Efficient capital markets: a review of theory and empirical work. *The Journal of Finance*, 383–417.
- Feng, L., & Seasholes, M. S. (2005). Do Investor Sophistication and Trading Experience Eliminate Behavioral Biases in Financial Markets? *Review of Finance*, 9(3), 305–351.
- Fleiss, J. L., Levin, B., & Cho Paik, M. (2003). Statistical Methods for Rates and Proportions (Third edition). *Wiley-Interscience (A John Wiley & Sons, Inc., Publication)*, 64-83.
- Frazzini, A. (2006). The Disposition Effect and Underreaction to News. *Journal of Finance*, 61(4), 2017–2046.
- Genesove, D., & Mayer, C. (2001). Loss Aversion and Seller Behavior: Evidence from the Housing Market. *The Quarterly Journal of Economics*, (November), 1233-1260.
- Gervais, S., & Odean, T. (2001). Learning to Be Overconfident. *The Review of Financial Studies*, 14(1), 1–27.
- Grinblatt, M., & Han, B. (2002). The Disposition Effect and Momentum. *Working Paper 8734 National Bureau of Economic Research*, 1-43.
- Grinblatt, M., & Han, B. (2005). Prospect Theory, Mental Accounting, and Momentum. *Journal of Financial Economics* 78 (2005), 311–339.
- Grinblatt, M., & Keloharju, M. (2001a). How Distance, Language, and Culture Influence Stockholdings and Trades. *The Journal of Finance*, Vol. LVI(3), 1053-1073.
- Grinblatt, M., & Keloharju, M. (2001b). What Makes Investors Trade? *The Journal of Finance*, Vol. LVI No. 2, April 2001, 589-616.
- Grinblatt, M., & Moskowitz, T. J. (2004). Predicting stock price movements from past returns: the role of consistency and tax-loss selling. *Journal of Financial Economics*, 71(3), 541–579.
- Gross, L. (1980). The art of selling intangibles: How to make your million (\$) by investing other people's money. *New York Institute of Finance*.

- Harris, L. (1988). Predicting Contemporary Volume with Historic Volume at Differential Price Levels: Evidence Supporting the Disposition Effect: Discussion. *Journal of Finance* 1, 43(3), 698–699.
- Heath, C., Huddart, S., & Lang, M. (1999). Psychological Factors and Stock Option Exercise. *Quarterly Journal of Economics*, (May), 601–627.
- Hens, T., & Vlcek, M. (2009). Does Prospect Theory Explain the Disposition Effect? *National Centre of Competence in Research Financial Valuation and Risk Management, Working Paper No. 247*
- Hirschleifer, D. (2001). Investor Psychology and Asset Pricing. *The Journal of Finance*, 56(4), 1533–1597.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: an analysis of decision under risk. *Econometrica*, 47(2), 263–291.
- Kaustia, M. (2004). Market-wide impact of the disposition effect: evidence from IPO trading volume. *Journal of Financial Markets*, 7(2), 207–235.
- Kliger, D., & Kudryavtsev, A. (2008). Reference point formation by market investors. *Journal of Banking & Finance*, 32(9), 1782–1794
- Lakonishok, J., & Smidt, S. (1986). Volume for Winners and Losers: Taxation and Other Motives for Stock Trading, *The Journal of Finance*, Vol. XLI(4), 951–975.
- Lee, C., Kraussl, R., & Paas, L. (2012). The effect of anticipated and experienced regret and pride on investors' future selling decisions. *CFS Working Paper, No. 2012/17*, 1-51
- Locke, P. R., & Mann, S. C. (2000). Do Professional Traders Exhibit Loss Realisation Aversion? *Working paper, Finance Department, School of Business and Public Management, The George Washington University*, 1-45
- Locke, P. R., & Mann, S. C. (2003). Professional Trader Discipline and Trade Disposition. *Working paper, Finance Department, School of Business and Public Management, The George Washington University*, 1-45.
- Malkiel, B. G. (2003). Efficient market hypothesis and its critics. *CEPS Working Paper No. 91 April 2003*, 1-47.
- Michenaud, S., & Solnik, B. (2008). Applying regret theory to investment choices: Currency hedging decisions. *Journal of International Money and Finance*, 27(5), 677–694.

- Muermann, A., & Volkman, J. M. (2006). Regret, Pride, and the Disposition Effect. *Working paper, The Wharton School, University of Pennsylvania*, 1-20.
- O'Curry Fogel, S., & Berry, T. (2006). The Disposition Effect and Individual Investor Decisions: The Roles of Regret and Counterfactual Alternatives. *Journal of Behavioral Finance*, 7(2), 107–116.
- Odean, T. (1998a). Are Investors Reluctant to Realize Their Losses? *Journal of Finance*, 53(5), 1775-1798.
- Odean, T. (1998b). Volume, Volatility, Price, and Profit When All Traders Are Above Average. *The Journal of Finance*, 53(6), 1887–1934.
- Page, M, & Way, C (1992). Stock Market Over-reactions: The South African Evidence. *Investment Analysts Journal*, Summer 1992/1993, 35-49.
- Pontiff, J. (2006). Costly arbitrage and the myth of idiosyncratic risk. *Journal of Accounting and Economics*, 42(1-2), 35–52.
- Poterba, J. M., & Weisbenner, S. J. (2001). Capital Gains Tax Rules, Tax-loss Trading, and Turn-of-the-year Returns. *The Journal of Finance*, LVI(1), 353–368.
- Prosad, J. M., Kapoor, S., & Sengupta, J. (2013). Impact of Overconfidence and the Disposition Effect on Trading Volume : An Empirical Investigation of Indian Equity Market. *International Journal of Research in Management and Technology*, 3(4), 109–116.
- Ritter, J. (1988). The Buying and Selling Behavior of Individual Investors at the Turn of the Year. *The Journal of Finance*, XLIII(3), 701-717.
- Ritter, J. (2003). Behavioral finance. *Pacific-Basin Finance Journal*, 11(4), 429–437.
- Shapira, Z., & Venezia, I. (2000). Patterns of Behaviour of Professionally Managed and Independent Investors. *USC Marshall School of Business Working Paper No. 01-3 June 2000*, 1-25.
- Shefrin, H., & Statman, M. (1985). The Disposition to Sell Winners Too Early and Ride Losers Too Long: Theory and Evidence. *The Journal of Finance*, 40(3), 777–790.
- Shiller, R. J. (2003). From Efficient Markets Theory to Behavioural Finance. *The Journal of Economic Perspectives*, 17(1), 89–104.
- Shleifer, A., & Vishny, R. W. (2008). The Limits of Arbitrage. *The Journal of Finance*, 52(1), 35–55.

- Shumway, T., & Wu, G. (2006). Does Disposition Drive Momentum? *Working paper, Ross School of Business, University of Michigan, Bauer College of Business, University of Houston, 1-30.*
- Statman, M., Thorley, S., & Vorkink, K. (2006). Investor Overconfidence and Trading Volume. *Review of Financial Studies, 19(4), 1531–1565.*
- Strobl, G. (2003). Information Asymmetry, Price Momentum, and the Disposition Effect. *Working paper, Wharton School, University of Pennsylvania, 1-45.*
- Thaler, R. (1985). Mental accounting and consumer choice. *Marketing Science, 4(3), 199–214.*
- Thaler, R. H., & Shefrin, H. (1981). An Economic Theory of Self-Control. *Journal of Political Economy, 89(2), 392–406.*
- Titman, S., & Jegadeesh, N. (1993). Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency. *The Journal of Finance, 48(1), 65–91.*
- Tseng, K. C. (2006). BEHAVIORAL FINANCE, BOUNDED RATIONALITY, NEURO-FINANCE, AND TRADITIONAL FINANCE. *Investment Management and Financial Innovations, 2(4), 7–18.*
- Tversky, A., & Kahneman, D. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and Uncertainty, 5(4), 297–323.*
- Underhill, L., & Bradfield, D. (2013). *Introstat, Department of Statistical Sciences, University of Cape Town, 236-241.*
- Von Neumann, J., & Morgenstern, O. (1944). Theory of Games and Economic Behaviour. *Princeton University Press, 8-30, 603-616.*
- Weber, M., Glaser, M., & Noth, M. (2003). Behavioral Finance. Sonderforschungsbereich 504, *Rationalit, atskonzepte, Entscheidungsverhalten und okonomische Modellierung, No. 03-14, 1-31.*
- Zeelenberg, M., Beattie, J., van der Pligt, J., & de Vries, N. K. (2005). Consequences of Regret Aversion : Effects of Expected Feedback on Risky Decision Making. *Organisational Behaviour and Human Decision Processes, 65(2), 148–158.*

Appendices

Appendix 1: Behavioural Finance

(a) Efficient Market Hypothesis

Efficient Market Hypothesis, as proposed by Fama (1970) and which forms a basis for fundamental finance theory, assumes that financial markets would on average result in equilibrium prices which reflect publicly available information. In order for the market to reach this equilibrium, however, markets are assumed to be rational, which in turn requires rational investors (Ritter, 2003). This assumption that investors are, on average, rational is based on the premise that irrational investors will cancel one another out. This results in markets settling at equilibrium prices which reflect all publicly available information, becoming known as “efficient markets”. Further, it is assumed that if market participants were to act systematically irrationally, arbitrageurs would take advantage of the resultant asset mispricing, pushing the market back to equilibrium. (Ritter, 2003)

(b) The Limits to Arbitrage

The incorrect valuation of financial assets is common, and it is often possible to make profits off these incorrect valuations through arbitrage trading (Ritter, 2003). Incorrect asset pricings, as a result of incorrect valuation, are noted to come in two distinct forms: those which are recurrent and observable on a consistent basis, and those which are not recurrent and are once off (Ritter, 2003; Shiller, 2003; Shleifer & Vishny, 2008).

A profit can be made off recurrent incorrect valuations in the market through arbitrage trading, and the likes of hedge funds leverage off such incorrect pricing to make a profit. This action on the part of the market does result in relative market efficiency for such assets, as the actions on the part of hedge funds and other arbitrage participants largely mimics that proposed by the efficient market hypothesis (Ritter, 2003; Shleifer & Vishny, 2008). Furthermore, such arbitrage is dependent on large amounts of capital which is not limitless. However, the availability of capital does limit the ability of arbitrage traders in their execution of their arbitrage trades, therefore limiting their effect on correcting the incorrect valuation of assets. This limit imposed by capital restrictions does result in market inefficiency to some degree when recurrent incorrect valuations cannot be capitalised on by arbitrage traders (Pontiff, 2006; Shleifer & Vishny, 2008).

Non-recurrent incorrect valuations are more pertinent in their limiting of arbitrage. Where some incorrect pricings are observed to be recurrent and short term in nature, other incorrect pricings are observed over time which are long term and non-repeating (Shleifer & Vishny, 2008). In these cases,

the likes of hedge funds are unable, owing to liquidity restraints, to take advantage of the observed mispricing. Margin calls place limits on the realisation of arbitrage profits, thereby further exacerbating observed incorrect pricings as arbitrageurs are forced to exit trades so as to create liquidity. This limit to arbitrage was illustrated in the case of Long Term Capital Management, a hedge fund which was crippled by margin calls in 1998 despite their observation of a mispricing turning out to be correct in the long term (Barberis & Thaler, 2003; Ritter, 2003).

Such non-recurrent incorrect valuations which cannot be fixed by arbitrage market participants result in markets being observed, contrary to the efficient market hypothesis, to be inefficient. This inefficiency is as a direct consequence of systematic irrational behaviour on the part of market participants, and has been observed worldwide in cases such as the undervaluation of world-wide stock markets from 1974-1982, the Japanese stock price and land price bubble experienced in the 1980s, the Taiwanese stock price bubble which peaked in 1990, the world-wide October 1987 stock market crash and the IT bubble of the late 1990s (Ritter, 2003).

Appendix 2: Prospect Theory

2.1 Conventional utility theory

Conventional expected utility theory, based primarily on the work of Von Neumann and Morgenstern (1944), assumed that people maximise utility on a rational basis by maximising their wealth in monetary terms (Barberis & Thaler, 2003). Expected utility theory was based upon four axioms of human behaviour: completeness, transitivity, continuity and independence.

Completeness requires that individuals have clearly defined preferences. Transitivity requires that independent decisions are consistent with one another in terms of the preferences of the individual making the decision. Continuity requires that there is a specific point at which one option becomes superior to another, allowing for distinct separation of preferences. Independence requires that a preference holds regardless of the possibility of other alternatives. If an individual were to satisfy these four rational behavioural characteristics, therefore being “Von Neumann Morgenstern rational”, they were hypothesised to maximise their utility based on the following three tenets (Kahneman & Tversky, 1979):

- i. Expectation: the overall utility of a prospect is the probability weighted utility of all possible outcomes.
- ii. Asset integration: a prospect is adequate if the utility of the person’s entire asset set with the new prospect is greater than the utility of the asset set without the new prospect. A person’s asset set is most commonly associated with monetary wealth.
- iii. Risk aversion: risk aversion refers to when a person prefers a certain outcome over a risky prospect with the same expected value. The risk aversion of an individual is assumed to be uniform over gains and losses, resulting in a concave utility function (Von Neumann & Morgenstern, 1944).

Experimental work in response to Von Neumann and Morgenstern (1944) in subsequent decades has shown that people systematically violate expected utility theory when faced with choices between risky gambles. Academic investigation into the subject increased dramatically as a result of expected utility theory not holding, resulting in multiple works being published which attempted to align observed behaviour with sound utility theory. One of the best known such theories to be published was proposed by Kahneman & Tversky (1979), who named their theory “prospect theory” (Barberis & Thaler, 2003).

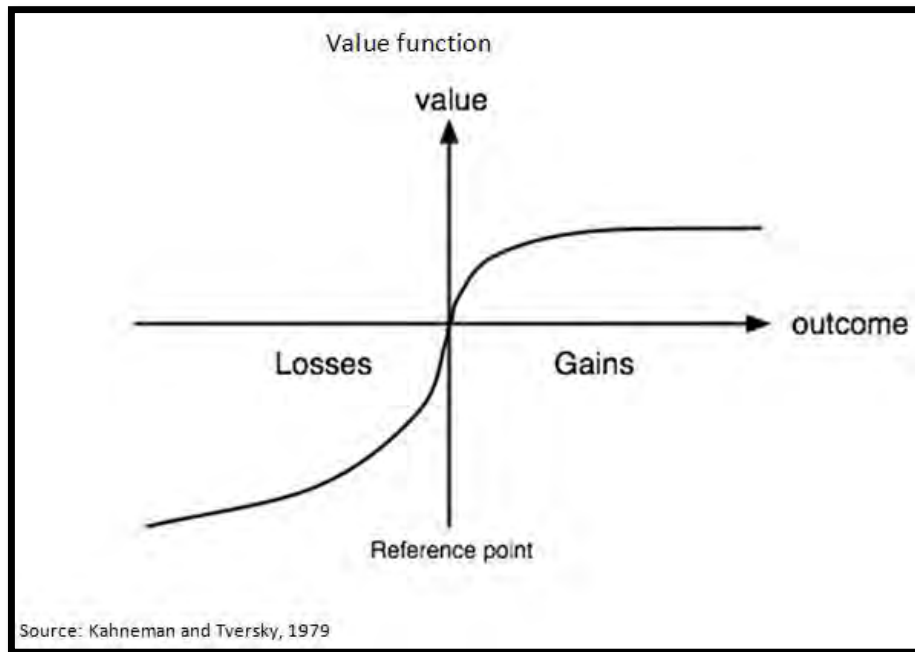
2.2 Prospect Theory

Prospect theory was first proposed by Kahneman and Tversky (1979) as a review of traditional models of expected utility theory for decision making under conditions of risk and uncertainty. In their paper titled “Prospect theory: an analysis of decision making under risk”, Kahneman and Tversky (1979) suggested that people’s choices under uncertainty in reality contradicted those predicted by expected utility theory resulting from an uncertain outcome.

Based on experimental findings, Kahneman and Tversky (1979) proposed that under prospect theory, people evaluate gambles by thinking in terms of gains and losses, and not in terms of final wealth levels per conventional expected utility theory (point (ii) under 2.1 above). It is also proposed by Kahneman and Tversky (1979) that people’s risk aversion is not uniform about gains and losses (per point (iii) under 2.1 above), but is concave for gains and convex for losses. Gains and losses are therefore processed on a value function which is asymmetrically concave for gains and convex for losses, not merely concave for all outcomes (Kahneman & Tversky, 1979).

In addition, Kahneman and Tversky (1979) incorporate the observation that a loss of equal magnitude to a gain results in more negative utility than the gain: the pain of losing a sum of money seems to outweigh the joy of receiving the same amount. This results in the value function being steeper in losses than in gains.

The proposed value function therefore bears the following three characteristics: (i) gains and losses are defined relative to a reference point, not overall wealth, (ii) the curve is concave for gains and convex for losses, and (iii) the curve is steeper for losses than for gains. The value curve depicting these characteristics is shown below: (Kahneman & Tversky, 1979)



This value curve infers that people are risk averse for gains and risk seeking for losses, with more weight being placed on losses than on gains. Further, it is inferred by the respective convexity and concavity of the curve that marginal utility diminishes as the size of the gain or loss increases, resulting in a limit to the utility achievable for any size gain or loss (Barberis & Xiong, 2009; Kahneman & Tversky, 1979; Odean, 1998a; Tversky & Kahneman, 1992).

Appendix 3A: Sample Data (full sample)

Table 3.1: Sample Data (full sample)

	Non-Managed	Managed
Number of Accounts	3 275	1 565
Number of Sales	27 463	67 368
- Gains	20 787	44 594
- Losses	6 676	22 774
Number of Paper Positions	975 983	779 503
- Gains	654 296	511 632
- Losses	321 687	267 871

Table 3.2: Minimum sample sizes for statistical relevance (full sample)

	PLR (Non-managed)	PLR (Managed)
Calculated proportion	0.0203	0.0802
Minimum observations	1 235	1 235
Actual observations	328 363	290 645
Sample size large enough?	Yes	Yes

Figure 3.1: PGR - PLR ("non-managed", full sample)

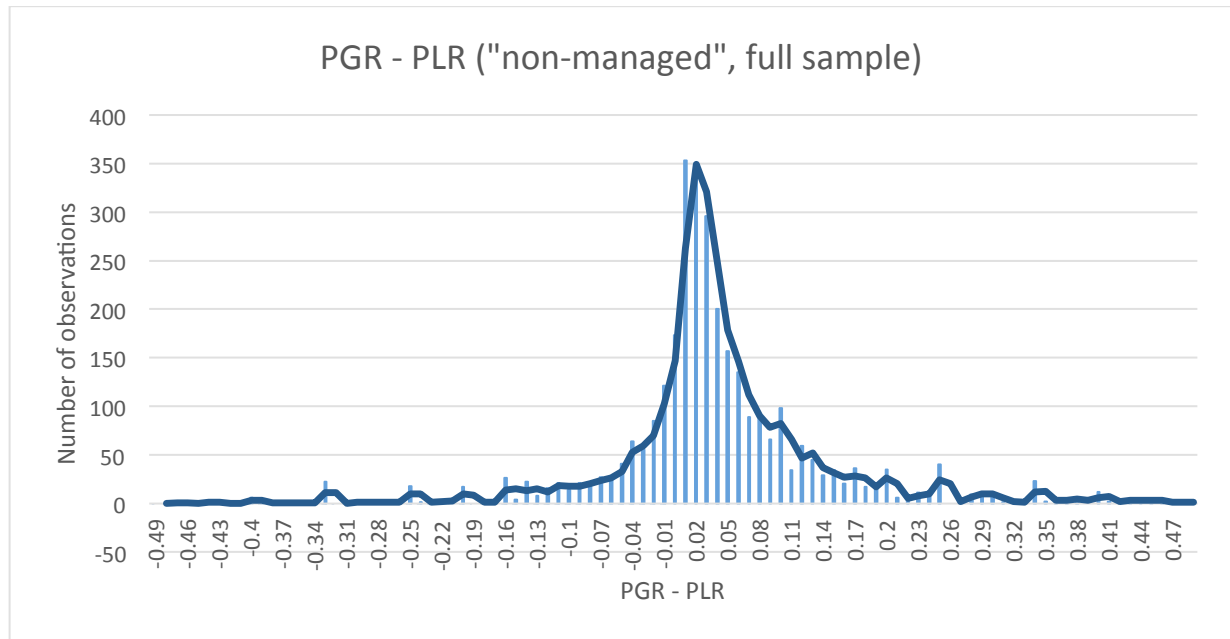
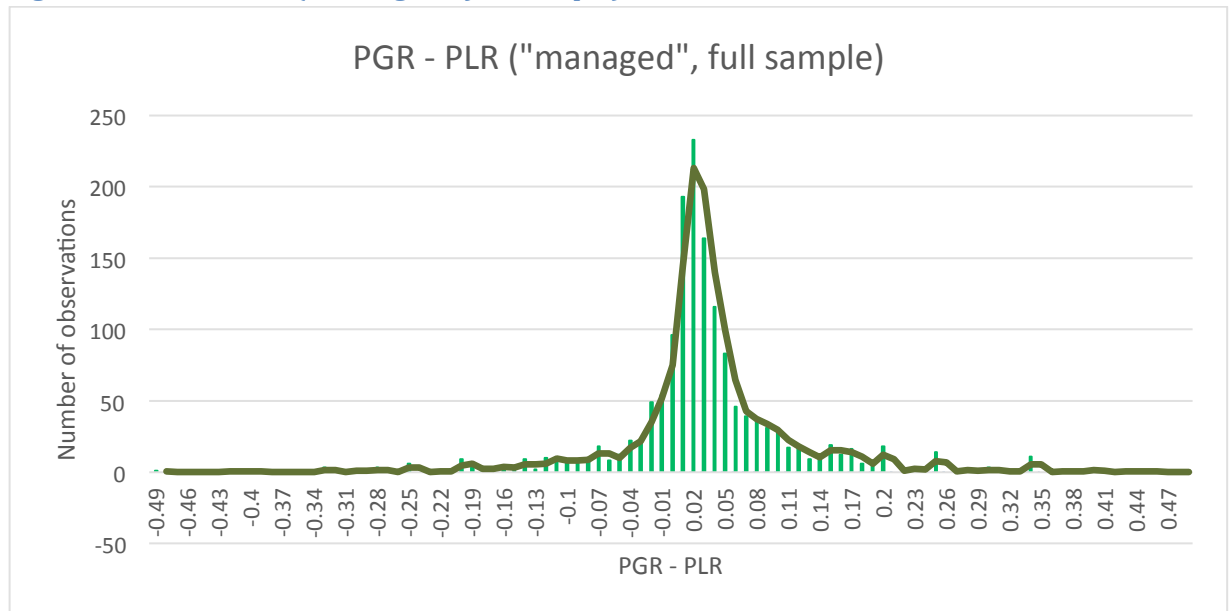


Figure 3.2: PGR - PLR ("managed", full sample)



Appendix 3B: Sample Data (aggregated monthly)

Table 3.3: Sample data – “non-managed accounts” (aggregated monthly)

"Non-managed" Accounts							
	Paper Gains	Paper Losses	Realised Gains	Realised Losses	PGR	PLR	PGR-PLR
January	49 197	20 830	1 456	466	2.87%	2.19%	0.69%
February	51 336	24 801	1 496	592	2.83%	2.33%	0.50%
March	51 868	27 494	1 681	579	3.14%	2.06%	1.08%
April	44 432	23 330	1 363	405	2.98%	1.71%	1.27%
May	55 788	31 292	1 693	680	2.95%	2.13%	0.82%
June	57 743	30 874	1 371	571	2.32%	1.82%	0.50%
July	59 040	31 593	1 943	633	3.19%	1.96%	1.22%
August	68 364	34 512	2 108	739	2.99%	2.10%	0.89%
September	62 457	28 016	2 066	543	3.20%	1.90%	1.30%
October	64 035	28 602	2 404	638	3.62%	2.18%	1.44%
November	54 166	23 759	1 973	521	3.51%	2.15%	1.37%
December	35 870	16 584	1 233	309	3.32%	1.83%	1.49%
February	51 336	24 801	1 496	592	2.83%	2.33%	0.50%
March - January	602 960	296 886	19 291	6 084	3.10%	2.01%	1.09%

Table 3.4: Sample data – “managed accounts” (aggregated monthly)

"Managed" Accounts							
	Paper Gains	Paper Losses	Realised Gains	Realised Losses	PGR	PLR	PGR-PLR
January	42 492	18 149	3 807	1 625	8.22%	8.22%	0.00%
February	40 510	21 874	3 498	1 779	7.95%	7.52%	0.43%
March	42 669	23 323	3 543	2 117	7.67%	8.32%	-0.65%
April	37 385	19 715	3 303	1 806	8.12%	8.39%	-0.27%
May	43 507	24 196	3 751	2 207	7.94%	8.36%	-0.42%
June	41 403	25 710	3 583	1 826	7.96%	6.63%	1.33%
July	43 621	25 607	3 809	2 054	8.03%	7.43%	0.61%
August	45 115	25 728	3 910	2 129	7.98%	7.64%	0.33%
September	48 258	23 387	4 015	1 928	7.68%	7.62%	0.06%
October	53 459	24 588	4 585	1 913	7.90%	7.22%	0.68%
November	39 807	19 547	3 721	1 833	8.55%	8.57%	-0.02%
December	33 406	16 047	3 069	1 557	8.41%	8.84%	-0.43%
February	40 510	21 874	3 498	1 779	7.95%	7.52%	0.43%
March - January	471 122	245 997	41 096	20 995	8.02%	7.86%	0.16%

Table 3.5: Minimum sample sizes for statistical relevance (data aggregated monthly)

	PGR – PLR (March – January) (Non-managed)	PGR – PLR (March – January) (Managed)
Calculated proportion	0.0109	0.0016
Minimum observations	1 235	1 235
Actual observations	925 221	779 210
Sample size large enough?	Yes	Yes

Appendix 3C: Sample Data (whole sales only)

Table 3.6: Sample data (whole sales only)

	Non-Managed	Managed
Number of Accounts	2 406	1 068
Number of Sales	9 298	5 168
- Gains	6 818	3 345
- Losses	2 480	1 823
Number of Paper Positions	873 793	711 379
- Gains	583 394	458 924
- Losses	290 399	252 455

Table 3.7: Minimum sample sizes for statistical relevance (whole sales only)

	PLR _{whole sales only} (Non-managed)	PLR _{whole sales only} (Managed)
Calculated proportion	0.0085	0.0072
Minimum observations	1 235	1 235
Actual observations	292 879	254 278
Sample size large enough?	Yes	Yes

Figure 3.3: PGR - PLR ("non-managed", whole sales)

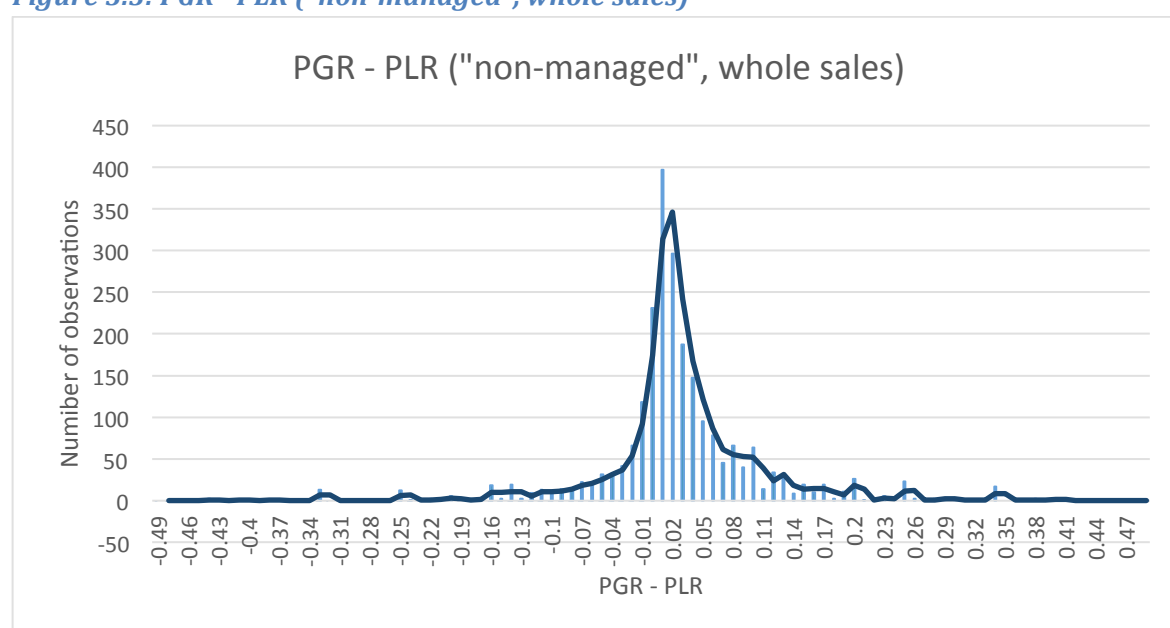
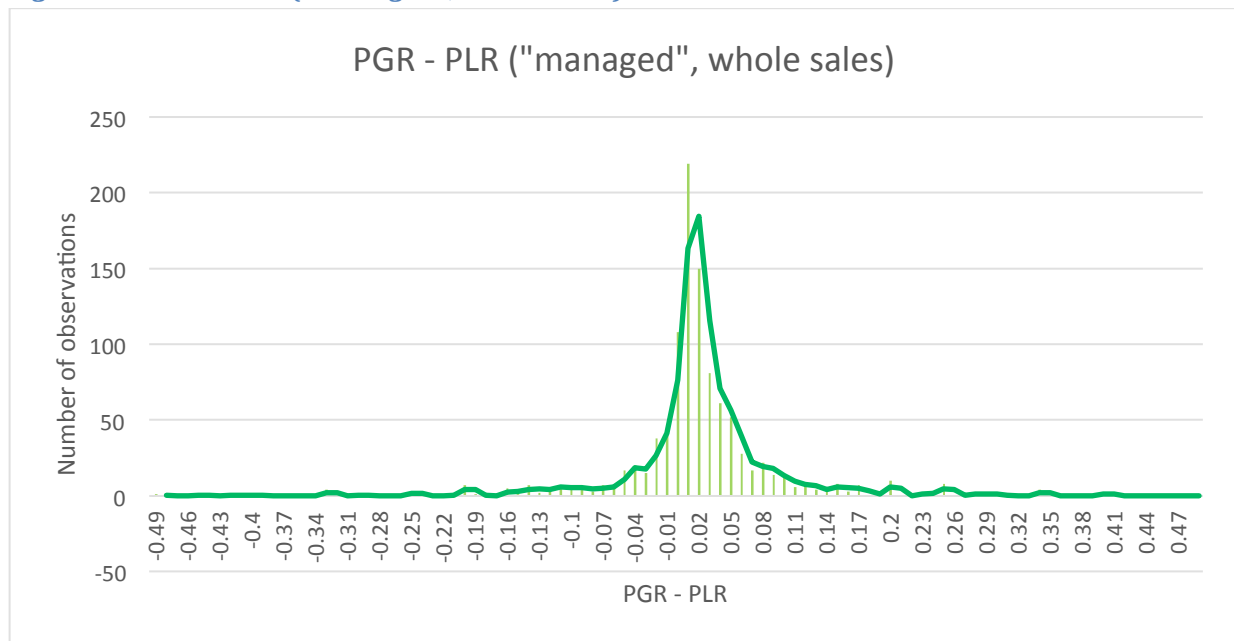


Figure 3.4: PGR - PLR ("managed", whole sales)



Appendix 4: Results of testing

Table 4.1: The disposition effect for managed and non-managed accounts

	Non-managed accounts		Managed accounts	
	Overall	Average per account	Overall	Average per account
PGR (%)	3.08	8.11	8.02	6.95
PLR (%)	2.03	4.31	7.84	3.85
Difference (PGR-PLR) (%)	1.05	3.80	0.18	3.10
PGR/PLR	1.51	1.88	1.02	1.81
% investors where PGR>PLR	-	73.50	-	75.34
z-stat	- 32.30	- 13.09	- 2.94	- 8.65
Significance	p < 0.01	p < 0.01	p < 0.01	p < 0.01
Accept/reject H ₀ at 1% level	Reject	Reject	Reject	Reject
Z-stat for difference between managed and non-managed = - 12.40, therefore reject H ₀ at 1% level.				

$$\text{Standard error} = \sqrt{\frac{PGR(1 - PGR)}{n(\text{paper} + \text{realised gains})} + \frac{PLR(1 - PLR)}{n(\text{paper} + \text{realised losses})}}$$

Table 4.2: The extent of the disposition effect by month

	Non-managed	Managed
PGR		
- February	2.83%	7.95%
- March to January	3.10%	8.02%
PLR		
- February	2.33%	7.52%
- March to January	2.01%	7.86%
PGR - PLR		
- February	0.50%	0.43%
- March to January	1.09%	0.16%
z-stat for difference	-4.78	1.19
Significance	p < 0.01	p < 0.89
Accept/reject H₀ at 1% level	Reject	Accept

Table 4.3: The disposition effect for “non-managed” and “managed” accounts when controlled for portfolio rebalancing

	Non-managed accounts		Managed accounts	
	Overall	Average per account	Overall	Average per account
PGR (%)	1.16	5.24	0.72	4.64
PLR (%)	0.85	2.83	0.72	2.92
Difference (%)	0.31	2.41	0.008	1.72
% investors where PGR>PLR	-	70.00	-	69.99
z-stat	- 14.08	- 8.57	- 0.31	- 4.39
Significance	p < 0.01	p < 0.01	p < 0.38	p < 0.01
Accept/reject H₀ at 1% level	Reject	Reject	Accept	Reject
Z-stat for the difference between non-managed and managed = - 9.97, therefore reject H₀ at 1% level.				

Figure 4.1: PGR/PLR (“non-managed” accounts) by month

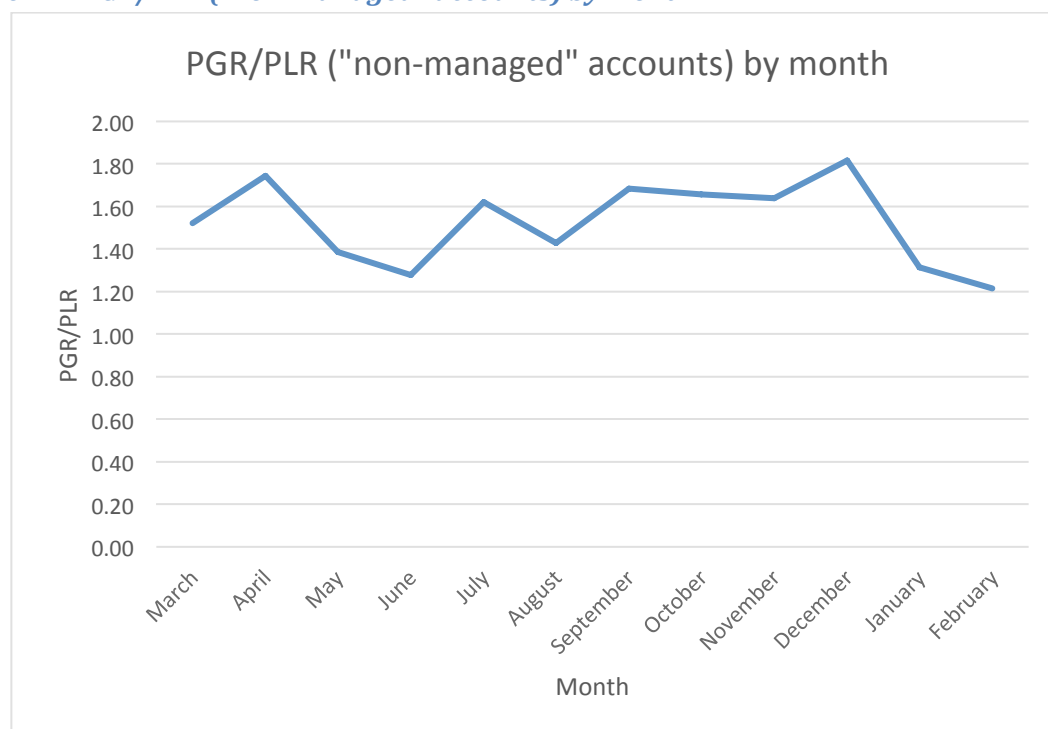
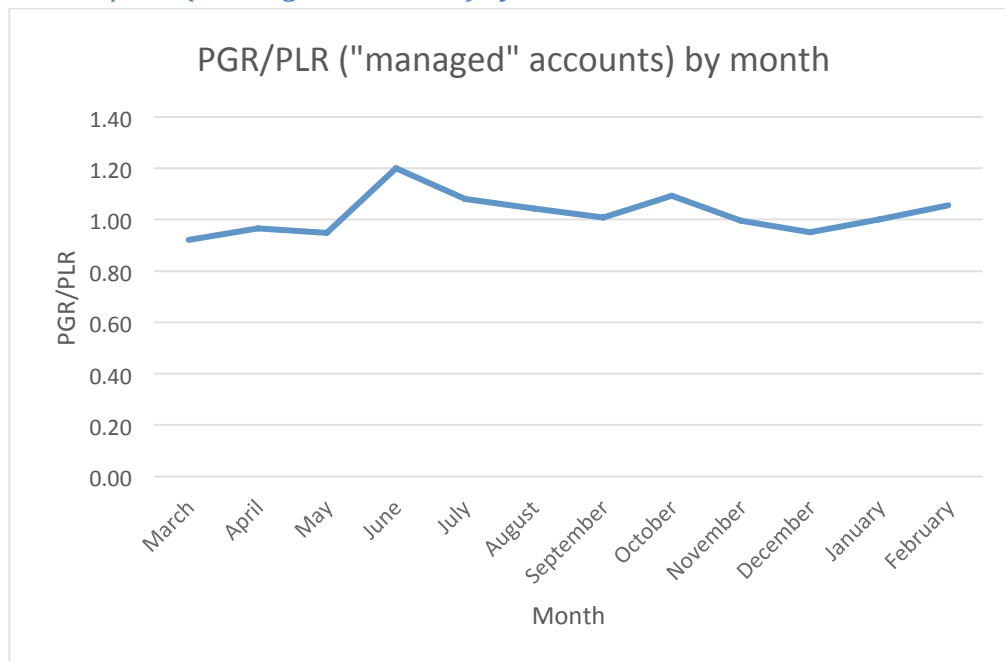


Figure 4.2: PGR/PLR ("managed" accounts) by month



Appendix 5: Analysis of results

Table 5.1: Frequency index buckets for “non-managed” accounts

Bucket	Total PGR-PLR	PGR/PLR	Average PGR-PLR per account	Frequency Index	Total sales	Opportunities to sell	% of total
1	0.12	1.95	0.19	0.20	2522	12397	1%
2	0.06	1.77	0.07	0.12	3214	27179	3%
3	0.03	1.59	0.05	0.07	3067	42206	4%
4	0.02	1.65	0.03	0.05	2695	49341	5%
5	0.02	1.50	0.02	0.04	5006	121493	12%
6	0.01	1.59	0.01	0.03	3889	124648	12%
7	0.01	1.58	0.01	0.02	2715	115157	11%
8	0.01	1.73	0.00	0.02	1808	109636	11%
9	0.00	1.36	0.00	0.01	1510	145038	14%
10	0.00	1.52	0.00	0.00	1037	256351	26%
Total	0.01	1.51	0.04	0.03	27463	1003446	100%

Table 5.2: Frequency index buckets for “managed” accounts

Bucket	Total PGR-PLR	PGR/PLR	Average PGR-PLR per account	Frequency Index	Total sales	Opportunities to sell	% of total
1	0.04	1.24	0.13	0.20	53366	271029	32%
2	0.04	1.67	0.08	0.09	1028	10877	1%
3	0.02	1.47	0.03	0.06	1217	18949	2%
4	0.03	1.95	0.03	0.05	5394	108390	13%
5	0.01	1.56	0.02	0.03	1102	32843	4%
6	0.01	1.73	0.02	0.03	1695	65233	8%
7	0.00	1.29	0.01	0.02	878	44795	5%
8	0.00	1.24	0.01	0.01	1085	82568	10%
9	0.00	1.15	0.00	0.01	1187	127358	15%
10	0.00	0.81	0.00	0.00	416	84829	10%
Total	0.00	1.02	0.03	0.08	67368	846871	100%

Figure 5.1: PGR - PLR per frequency index bucket

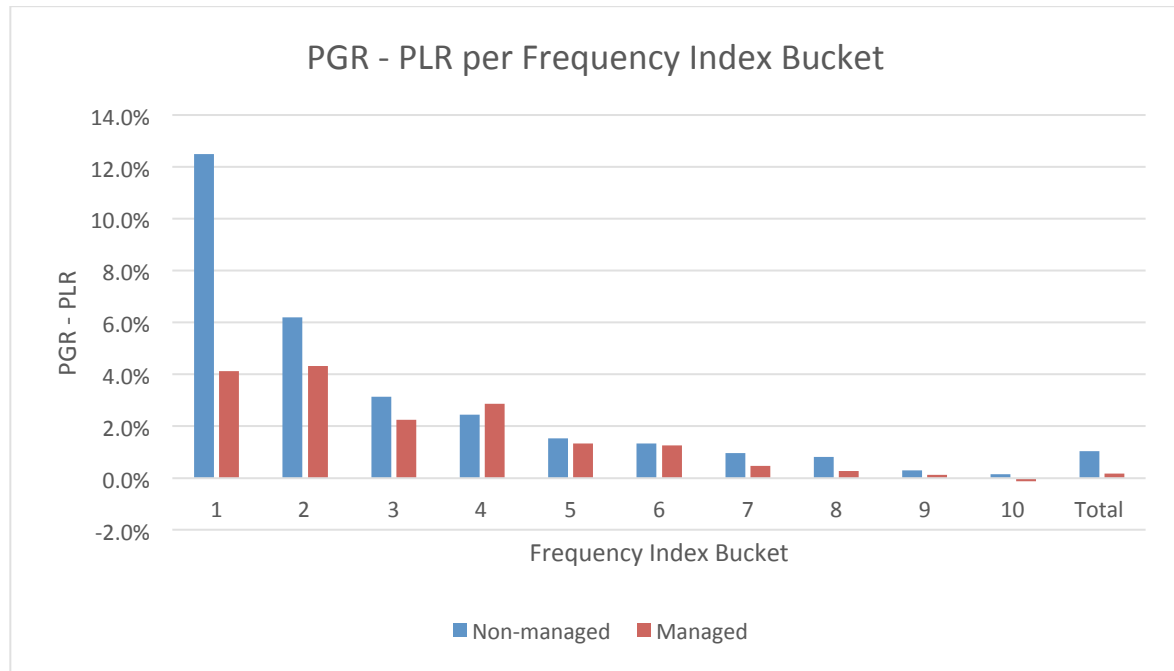


Figure 5.2: PGR/PLR per frequency index bucket

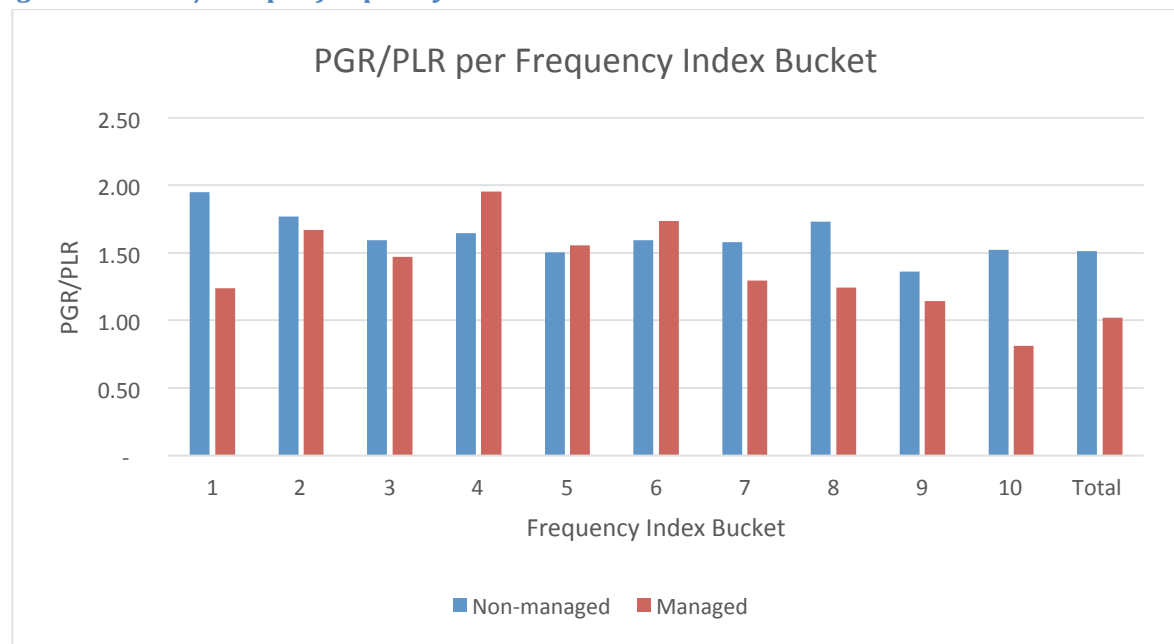


Figure 5.3: PGR/PLR per frequency index bucket

